THE LIBRARY
OF
THE UNIVERSITY
OF CALIFORNIA
DAVIS

STATE OF CALIFORNIA
DEPARTMENT OF NATURAL RESOURCES
FRED G. STEVENOT, Director
DIVISION OF MINES
FERRY BUILDING, SAN FRANCISCO
WALTER W. BRADLEY State Mineralogist

San Francisco] BULLETIN No. 102 [September, 1929

CALIFORNIA MINERAL PRODUCTION FOR 1928

LIBRARY COPY
U. S. FOREST SERVICE
California District
San Francisco, California

CALIFORNIA STATE PRINTING OFFICE
SACRAMENTO, 1930
71043

STATE OF CALIFORNIA
DEPARTMENT OF NATURAL RESOURCES
FRED G. STEVENOT, Director

DIVISION OF MINES
FERRY BUILDING, SAN FRANCISCO

WALTER W. BRADLEY State Mineralogist

San Francisco] BULLETIN No. 102 [September, 1929

CALIFORNIA MINERAL PRODUCTION FOR 1928

By
HENRY H. SYMONS

71043

LIBRARY
UNIVERSITY OF CALIFORNIA
DAVIS

CONTENTS

Page

LETTER OF TRANSMITTAL 7
INTRODUCTION 9

CHAPTER I

SUMMARY OF THE MINERAL INDUSTRY IN CALIFORNIA DURING THE YEAR OF 1928 11
TABULATION OF THE MINERAL PRODUCTION, SHOWING COMPARATIVE AMOUNTS AND VALUES—1927 AND 1928 14
TABLE SHOWING COMPARATIVE MINERAL PRODUCTION OF THE VARIOUS COUNTIES IN CALIFORNIA FOR 1927 AND 1928 16
TOTAL PRODUCTION, 1887–1928 17

CHAPTER II

FUELS (HYDROCARBONS)—
INTRODUCTORY 18
COAL 18
NATURAL GAS 19
PETROLEUM 26

CHAPTER III

METALS—
INTRODUCTORY 38
ALUMINUM 42
ANTIMONY 42
ARSENIC 43
BERYLLIUM 44
BISMUTH 44
CADMIUM 44
COBALT 45
COPPER 45
GOLD 48
IRIDIUM. (*See* Platinum.)
IRON 52
LEAD 52
MANGANESE 54
MOLYBDENUM 55
NICKEL 56
OSMIUM. (*See* Platinum.)
PALLADIUM. (*See* Platinum.)
PLATINUM 56
QUICKSILVER 58
SILVER 60
TIN 62
TITANIUM 63
TUNGSTEN 64
VANADIUM 65
ZINC 66

CHAPTER IV

STRUCTURAL MATERIALS—
INTRODUCTORY 68
ASPHALT 69
BITUMINOUS ROCK 69
BRICK AND HOLLOW TILE 70
CEMENT 72
CHROMITE 74
GRANITE 76
LIME 79
MAGNESITE 80
MARBLE 83
ONYX AND TRAVERTINE 83
SANDSTONE 84
SERPENTINE 85
SLATE 85
STONE—MISCELLANEOUS 86
Paving Blocks 88
Grinding Mill Pebbles 89
Sand and Gravel 90
Crushed Rock 91

CHAPTER V

INDUSTRIAL MATERIALS—
INTRODUCTORY 95
ASBESTOS 96
BARYTES 97
CLAY—POTTERY 98
DIATOMACEOUS EARTH 100

INDUSTRIAL MATERIALS—Continued. Page

Dolomite ---- 102
Feldspar ---- 103
Fluorspar ---- 104
Fuller's Earth ---- 104
Gems ---- 105
Graphite ---- 107
Gypsum ---- 108
Limestone ---- 110
Lithia ---- 111
Mica ---- 111
Mineral Paint ---- 112
Mineral Water ---- 113
Phosphates ---- 115
Pumice and Volcanic Ash ---- 115
Pyrites ---- 116
Shale Oil ---- 117
Silica (Sand and Quartz) ---- 118
Sillimanite—Andalusite—Cyanite Group ---- 119
Soapstone and Talc ---- 120
Strontium ---- 122
Sulphur ---- 123

Chapter VI

SALINES—

Introductory ---- 124
Borates ---- 124
Bromine ---- 126
Calcium Chloride ---- 127
Magnesium Salts ---- 127
Nitrates ---- 128
Potash ---- 129
Salt ---- 132
Soda ---- 132

Chapter VII

MINERAL PRODUCTION OF CALIFORNIA BY COUNTIES—

Introductory ---- 134
Alameda ---- 135
Alpine ---- 135
Amador ---- 136
Butte ---- 136
Calaveras ---- 137
Colusa ---- 137
Contra Costa ---- 138
Del Norte ---- 138
El Dorado ---- 139
Fresno ---- 139
Glenn ---- 140
Humboldt ---- 140
Imperial ---- 141
Inyo ---- 141
Kern ---- 142
Kings ---- 142
Lake ---- 143
Lassen ---- 143
Los Angeles ---- 144
Madera ---- 144
Marin ---- 145
Mariposa ---- 145
Mendocino ---- 146
Merced ---- 146
Modoc ---- 147
Mono ---- 147
Monterey ---- 147
Napa ---- 148
Nevada ---- 148
Orange ---- 149
Placer ---- 149
Plumas ---- 150
Riverside ---- 150
Sacramento ---- 151
San Benito ---- 151
San Bernardino ---- 152
San Diego ---- 153
San Francisco ---- 153
San Joaquin ---- 153
San Luis Obispo ---- 154
San Mateo ---- 154
Santa Barbara ---- 155
Santa Clara ---- 155
Santa Cruz ---- 156
Shasta ---- 156
Sierra ---- 157

MINERAL PRODUCTION OF CALIFORNIA BY COUNTIES—Continued. Page
Siskiyou ---- 157
Solano ---- 158
Sonoma ---- 158
Stanislaus ---- 158
Sutter ---- 159
Tehama ---- 159
Trinity ---- 160
Tulare ---- 160
Tuolumne ---- 161
Ventura ---- 161
Yolo ---- 162
Yuba ---- 162

APPENDIX A

DIRECTORY OF PRODUCERS OF METALLIC AND NONMETALLIC MINERALS IN CALIFORNIA, 1928 ---- 163
Introductory ---- 163
Antimony ---- 165
Asbestos ---- 165
Barites ---- 165
Bituminous Rock ---- 165
Borates ---- 166
Bromine ---- 166
Calcium Chloride ---- 166
Cement ---- 166
Chromite ---- 167
Clay ---- 168
Coal ---- 172
Copper ---- 172
Diatomaceous Earth ---- 172
Dolomite ---- 173
Feldspar ---- 173
Fuller's Earth ---- 173
Gems ---- 174
Granite ---- 175
Gypsum ---- 176
Iron and Titanium ---- 176
Lead ---- 176
Lime and Limestone ---- 177
Lithia ---- 177
Magnesite ---- 178
Manganese ---- 178
Magnesium Salts ---- 178
Marble (including Onyx and Travertine) ---- 178
Mineral Paint ---- 178
Mineral Water ---- 179
Platinum ---- 180
Potash ---- 180
Pumice and Volcanic Ash ---- 181
Pyrite ---- 181
Quicksilver ---- 182
Salt ---- 183
Sandstone ---- 183
Silica (Sand and Quartz) ---- 184
Sillimanite—Andalusite—Cyanite Group ---- 184
Slate ---- 184
Soapstone and Talc ---- 185
Soda ---- 185
Stone, Miscellaneous ---- 186
Tin ---- 193
Tungsten ---- 193

APPENDIX B

MINING BUREAU ACT ---- 194
DEPARTMENT OF NATURAL RESOURCES ACT ---- 197
PUBLICATIONS OF THE STATE DIVISION OF MINES AND MINING ---- 199
INDEX ---- 210

ILLUSTRATIONS AND PHOTOS

	Page
Dudley Ridge Syndicate, Kings County, gas well throwing sand and water into air	22
Elliott No. 1 well of Milham Exploration Co., the discovery well of the Kettleman Hills Oil Field, Kings County	26
Plant of Walker Mining Company near Spring Garden, Plumas County	41
New steel headframe at Kennedy Mine, Jackson, Amador County	49
Douglas Memorial Bridge over Klamath River, Del Norte County, a reinforced concrete structure	73
Quarry of Webber Construction Co. at Crescent City, Del Norte County. Source of rock breakwater construction	87
Large sling rock from Webber Construction Co. quarry for Crescent City breakwater	88
Plant of Russian River Gravel Co., Healdsburg	91
Sand plant of John Freitas, Ukiah	91
Diatomaceous earth plant of Pacatome Co. at Bradley, Monterey County	101
Gypsum plant of the Pacific Portland Cement Co. at Plaster City, Imperial County	109
Arrowhead Hot Springs, San Bernardino County, bathhouse installation at steam cave	114

CHARTS AND MAPS

Outline map of California, showing natural gas pipe lines	20
Outline map of California, showing location of oil fields and districts	35
Chart showing current trend of world production of major nonferrous metals	39
Chart showing prices of electrolytic copper	46
Chart showing prices of common lead	53
Chart showing prices of bar silver	61
Chart showing prices of slab zinc	66

LETTER OF TRANSMITTAL

September, 1929.

To His Excellency, The Honorable C. C. Young,
Governor of the State of California.

Sir: I have the honor to herewith transmit Bulletin No. 102 of the State Division of Mines, being the annual report of the statistics of the mineral production of California.

The remarkable variety, total valuation, and wide distribution of many of our minerals revealed herein show California's importance as a producer of commercial minerals among the states of the Union.

Respectfully submitted.

Walter W. Bradley,
State Mineralogist.

INTRODUCTION

It is the endeavor of the staff of the State Division of Mines (formerly State Mining Bureau), in these annual reports of the mineral industries of California, to so compile the statistics of production that they will be of actual use to producers and to those interested in the utilization of the mineral products of our state, while at the same time keeping the individual's data confidential. In addition to the mere figures of output, we have included descriptions of the uses and characteristics of many of the materials, as well as a brief mention of their occurrences.

The compilation of accurate and dependable figures is an extremely difficult undertaking, and the State Mineralogist takes the opportunity of here expressing his appreciation of the cooperation of the producers in making this work possible. A fuller appreciation of the value of early responses to the requests sent out in January will result in earlier completion of the manuscript. Statistics lose much of their value if their publication is unnecessarily delayed.

Some of the data relative to properties and uses of many of the minerals herein described are repeated from preceding reports, as it is intended that this annual statistical bulletin shall be somewhat of a compendium of information on California's commercial minerals and their utilization.

WALTER W. BRADLEY,
State Mineralogist.

MINERAL INDUSTRY, CALIFORNIA, 1928

DATA COMPILED FROM DIRECT RETURNS FROM PRODUCERS IN ANSWER TO INQUIRIES SENT OUT BY THE CALIFORNIA STATE DIVISION OF MINES, FERRY BUILDING, SAN FRANCISCO, CALIFORNIA

CHAPTER ONE

The total value of the mineral output for the year 1928 was $332,714,233, being a decrease of $34,067,161 from the 1927 total of $366,781,394. There were fifty-four different mineral substances, exclusive of a segregation of the various stones grouped under gems; and all of the fifty-eight counties of the state contributed to the list.

As revealed by the data following, the salient features of 1928 compared with the preceding year are: A large drop in the value of the petroleum yield, also material decreases in the value of brick and hollow building tile, cement, gold, granite, and miscellaneous stone; which were partly offset by marked increases in both quantity and value of the following: borates, clay (pottery), fuller's earth, natural gas, quicksilver, potash and salt. Petroleum showed a decrease in value of $30,736,818, although there was an increase in amount from 231,195,774 barrels to 231,811,465 barrels. This was due to the low price of crude oils which prevailed throughout the year; while natural gas increased from 224,686,940 M cubic feet, worth $20,447,294, to 260,887, 116 M cubic feet, worth $22,260,947. The net results were increases in the industrial and saline group, while all other groups showed a decline.

Of the metals, a production of tin was reported, the first time since 1892; quicksilver increased from 6488 (75-pound) flasks, worth $714,418, to 7107 (76-pound) flasks, worth $844,649, this being accounted for by the increased price received by the producers; in 1927 they received $111.67 per 75-pound flask, and in 1928 $118.88 per 76-pound flask. Copper, although there was a decrease in the amount, there was a slight increase in value, as shown 27,350,316 pounds, worth $3,582,885, to 25,162,304 pounds, worth $3,623,360; gold decreased from $11,671,018 to $10,785,315; lead from 2,748,440 pounds, worth $173,151, to 1,882,795 pounds, worth $109,102; silver from 1,620,242 fine ounces, worth $918,677, to 1,478,771 fine ounces, worth $865,081; and there was no reported production of zinc. In 1927 there were extremely low market prices in base metals, which forced several producers of copper, lead and zinc to suspend operations, and the revival of the market in 1928 only favorably affected the prices of copper; while the gold and silver, by-products of these ores, account for the decreases in the total gold and silver figures. Though the gold yield decreased in value, California continues to account for approximately 26 per cent of the gold output of the United States.

Of the structural group there was a general decrease in the amount and value owing to a decline in building in the cities. Brick and hollow building tile decreased from a value of $6,516,077 to $5,694,770; cement from 14,661,783 barrels, worth $26,474,935, to 13,625,231 barrels, worth $24,463,287; granite from a value of $1,398,443 to $763,996; and miscellaneous stone from a value of $18,912,994 to $17,332,110; of the remaining minerals in this group all showed a slight decline in amount and value with the exception of chromite and slate, both of which showed increases.

Of the industrial group there were a number of fluctuations with a general trend of increased productions and value. The important changes were: clay (pottery) with an increase from 867,419 tons, worth $872,661, to 887,807 tons, worth $1,394,950; fuller's earth from 13,018 tons, worth $154,764, to 53,323 tons, worth $501,743.

Of the saline group there was a general increased production and value, with the exception of bromine and magnesium salts, both of which showed slight decreases; potash showed the greatest increase, but the amount is concealed owing to a single producer; borates increased from 72,462 tons, worth $3,034,260, to 109,722 tons, worth $3,378,552; salt from 263,028 tons, worth, $639,127, to 340,480 tons, worth $1,024,656.

The figures of the State Division of Mines are made up from reports received direct from the producers of the various minerals. Care is exercised in avoiding duplication, and any error is likely to be on the side of under- rather than over-estimation.

California yields, commercially, a greater number and variety of mineral products than any state in the United States, and probably more than any other equal area elsewhere on the earth. The total annual value of her output has been surpassed by not more than four or five others, and those usually the great coal states of east of the Mississippi. More recently California has been placed second to Pennsylvania, the leader. California was for many years the sole domestic source of borax, chromite and magnesite, and in which we still lead. We lead all other states in the production of gold, quicksilver, and platinum; and have alternated in the lead with Colorado in tungsten, and with Oklahoma in petroleum.

The mineral industries, not only in California, but throughout the country, have reached quite a different phase from that of the old gold-rush days more than fifty years ago. A broader and more intimate status has been attained, touching practically every avenue of domestic and commercial endeavor. As quoted in a former report [1] of the freight handled by the railroads of the country, the products of the mines represent 51.33 per cent. While gold, in which California still leads the United States, is still important, other metals and even nonmetals have superseded it in annual value. The greatest commercial developments proportionately in California in recent years have taken place among the industrial and structural mineral, not to mention petroleum, which leads all others in value. This introduces a new factor which requires study and attention—that of marketing. The gold miner could, and still does, take his metal to the mint and receives its equivalent in the 'coin of the realm'; and he knows from day to

[1] Cal. State Min. Bur., Bulletin 96, p. 12, 1925.

day and year to year, without variation, just how much each ounce of gold will bring in that coin, though its equivalent in other commodities varies according to economic conditions. Marketing and competition, however, are vital factors in the industrial and structural groups.

By Substances

The following table shows the comparative yield of mineral substances of California for 1927 and 1928, as compiled from the returns received at the State Division of Mines, San Francisco, in answer to inquiry sent to producers:

Substance	1927 Amount	1927 Value	1928 Amount	1928 Value	Increase+ Decrease— Value
Antimony	*	*	20 tons	$761	*
Barytes	17,993 tons	$90,617	13,406 tons	55,888	$34,729—
Bituminous rock	3,515 tons	17,704	4 966 tons	33,832	16,128+
Borates	72,462 tons	3,043,260	109,722 tons	3,378,552	335,292+
Brick and hollow building tile	----------	6,516,077	----------	5,694,770	821,307—
Cement	14,661,783 bbls.	26,474,935	13,625,231 bbls.	24,463,27	2,011,648—
Chromite	225 tons	5,063	729 tons	15,179	10,116+
Clay (pottery)	867,419 tons	872,661	887,807 tons	1,394,950	522,289+
Coal	*	*	582 tons	3,442	* +
Copper	27,350,316 lbs.	3,582,885	25,162,304 lbs.	3,623,360	40,475+
Dolomite	45,976 tons	79,422	38,379 tons	85,342	5,920+
Feldspar	10,932 tons	86,101	14,628 tons	93,745	7,644+
Fuller's earth	13,018 tons	154,764	53,323 tons	501,743	346,979+
Gems	----------	7,035	----------	22,200	15,165+
Gold	----------	11,671,018	----------	10,875,315	885,703—
Granite	----------	1,398,443	----------	763,996	634,447—
Gypsum	94,630 tons	292,090	104,790 tons	200,567	91,523—
Lead	2,748,440 lbs.	173,151	1,882,795 lbs.	109,102	64,049—
Lime	60,498 tons	631,497	56,616 tons	547,919	83,578—
Limestone	699,790 tons	663,957	127,895 tons	397,935	266,022—
Magnesite	46,093 tons	577,887	45,645 tons	501,590	76,297—
Marble	[a] 42,308 cu. ft.	103,689	[a] 34,324 cu. ft.	82,190	21,499—
Mineral water	16,624,423 gals.	1,487,183	25,049,002 gals.	1,304,969	182,214—
Natural gas	224,686,940 M cu. ft.	20,447,294	260,887,116 M cu. ft.	22,260,947	1,813,653+
Petroleum	231,195,774 bbls.	260,735,498	231,811,465 bbls.	229,998,680	30,736,818—
Platinum	139 fine oz.	10,749	312 fine oz.	27,902	17,153+
Potash	67,340 tons	1,952,852	*	*	* +
Pumice and volcanic ash	13,779 tons	168,896	10,440 tons	105,055	63,841—
Pyrite	130,910 tons	564,823	90,566 tons	400,627	164,196—
Quicksilver	6,488 flasks	714,418	7,107 flasks	844,649	130,231+
Salt	263,028 tons	639,127	340,480 tons	1,024,656	385,529+
Sandstone	22,900 cu. ft.	205,400	134,100 cu. ft.	34,250	171,150—
Silica (sand and quartz)	24,636 tons	94,762	14,814 tons	66,679	28,083—
Silver	1,620,242 fine oz.	918,677	1,478,771 fine oz.	865,081	53,596—
Slate	----------	17,960	----------	31,263	13,303+
Soapstone and talc	16,218 tons	164,744	18,668 tons	251,372	86,628+
Soda	62,571 tons	1,478,239	80,838 tons	1,469,297	8,942—
Stone, miscellaneous [d]	----------	18,912,994	----------	17,332,110	1,580,884—
Zinc	8,625,004 lbs.	552,000	----------	----------	552,000—

Unapportioned	----------	[b] 1,273,522	----------	[c] 3,932,031	2,694,509+
Total value	----------	$366,781,394	----------	$332,714,233	----------
Net decrease					$34,067,161

* Included under 'Unapportioned.'
[a] Includes onyx and travertine.
[b] Includes antimony, asbestos, bromine, coal, graphite, diatomaceous earth, heptane, iron ore, lithia, magnesium salts, mineral paint, shale oil, sillimanite-andalusite-cyanite group, slate, titanium and tungsten.
[c] Includes asbestos, bromine, calcium chloride, diatomaceous earth, lithia, magnesium salt, manganese mineral paint, potash, sillimanite-andalusite-cyanite group, tin, titanium and tungsten.
[d] Includes macadam, ballast, rubble, riprap, sand and gravel, paving blocks, and grinding mill pebbles.

By Counties.

The following table shows the comparative value of the mineral production of the various counties in the state for the years 1927 and 1928:

	1927	*1928*
Alameda	$2,577,787	$2,421,830
Alpine	5,306	8,529
Amador	2,207,798	2,644,179
Butte	308,139	640,272
Calaveras	1,608,714	2,802,542
Colusa	13,207	36,500
Contra Costa	2,172,756	2,100,482
Del Norte	53,975	381,358
El Dorado	245,435	329,427
Fresno	7,547,216	4,227,286
Glenn	63,869	101,889
Humboldt	562,802	300,227
Imperial	350,977	241,678
Inyo	2,519,834	1,832,567
Kern	64,729,488	43,064,781
Kings	1,599	577,819
Lake	85,048	189,103
Lassen	39,425	76,499
Los Angeles	131,832,441	144,835,988
Madera	1,059,666	514,495
Marin	527,004	449,568
Mariposa	499,878	282,201
Mendocino	47,670	40,490
Merced	366,873	653,187
Modoc	62,251	30,440
Mono	102,187	214,420
Monterey	351,049	351,660
Napa	417,229	306,262
Nevada	2,213,709	2,023,886
Orange	60,547,041	39,655,177
Placer	360,224	333,135
Plumas	3,260,723	3,599,127
Riverside	6,543,369	6,274,901
Sacramento	2,348,916	2,389,645
San Benito	1,901,854	1,654,718
San Bernardino	16,140,703	14,157,381
San Diego	1,619,431	1,770,253
San Francisco	62,700	67,430
San Joaquin	711,965	624,931
San Luis Obispo	295,030	217,125
San Mateo	1,863,838	3,328,573
Santa Barbara	2,699,296	4,577,650
Santa Clara	990,876	1,021,541
Santa Cruz	3,473,209	3,323,920
Shasta	1,950,088	1,114,729
Sierra	752,533	679,925
Siskiyou	298,946	471,166
Solano	1,557,840	45,551
Sonoma	265,392	224,468
Stanislaus	393,089	472,158
Sutter	300	2,000
Tehama	5,350	14,389
Trinity	555,854	530,180
Tulare	474,173	445,366
Tuolumne	432,416	376,278
Ventura	30,995,379	31,116,675
Yolo	17,895	17,200
Yuba	3,679,632	2,529,076
Totals	$366,781,394	$332,714,233

Total Mineral Production of California, by Years.

The following tabulation gives the total value of mineral production of California by years since 1887, in which year compilation of such data by the State Mining Bureau (now Division of Mines) began. At the side of these figures have been placed the values of the most important metal and non-metal items—gold and petroleum.

In the same period copper made an important growth beginning with 1897 following the entry of the Shasta County mines, and more recently Plumas County. Cement increased rapidly from 1902, while crushed rock, sand and gravel as a group parallels the cement increase. Quicksilver has been up and down. Mineral water and salt have always been important items, but the values fluctuate. Borax has increased materially since 1896. War-time increases, 1915–1918, were shown by chromite, copper, lead, magnesite, manganese, silver, tungsten and zinc. Most of these, except silver, have since declined, though structural materials and copper increased in 1920–1924, also lead and magnesite in 1923; lead and zinc in 1925; zinc in 1926, with silver declining; an increase in quicksilver in 1927–28, with declines in other metals and by petroleum.

Total Mineral Production of California, by Years, Since 1887.

Year	Total value of all minerals	Gold, value	Petroleum, value
1887	$19,785,868	$13,588,614	$1,357,144
1888	19,469,320	12,750,000	1,380,666
1889	16,681,731	11,212,913	368,048
1890	18,039,666	12,309,793	384,200
1891	18,872,413	12,728,869	401,264
1892	18,300,168	12,571,900	561,333
1893	18,811,261	12,422,811	608,092
1894	20,203,294	13,923,281	1,064,521
1895	22,844,663	15,334,317	1,000,235
1896	24,291,398	17,181,562	1,180,793
1897	25,142,441	15,871,401	1,918,269
1898	27,289,079	15,906,478	2,376,420
1899	29,313,460	15,336,031	2,660,793
1900	32,622,945	15,863,355	4,152,928
1901	34,355,981	16,989,044	2,961,102
1902	35,069,105	16,910,320	4,692,189
1903	37,759,040	16,471,264	7,313,271
1904	43,778,348	19,109,600	8,317,809
1905	43,069,227	19,197,043	9,007,820
1906	46,776,085	18,732,452	9,238,020
1907	55,697,949	16,727,928	16,783,943
1908	66,363,198	18,761,559	26,566,181
1909	82,972,209	20,237,870	32,398,187
1910	88,419,079	19,715,440	37,683,542
1911	87,497,879	19,738,908	40,552,088
1912	88,972,385	19,713,478	41,868,344
1913	98,644,639	20,406,958	48,578,014
1914	93,314,773	20,653,496	47,487,109
1915	96,663,369	22,442,296	43,503,837
1916	127,901,610	21,410,741	57,421,334
1917	161,202,962	20,087,504	86,976,209
1918	199,753,837	16,529,162	127,459,221
1919	195,830,002	16,695,955	142,610,563
1920	242,099,667	14,311,043	178,394,937
1921	268,157,472	15,704,822	203,138,225
1922	245,183,826	14,670,346	173,381,265
1923	344,024,678	13,379,013	242,731,309
1924	374,620,789	13,150,175	274,652,874
1925	434,519,660	13,065,330	330,609,829
1926	450,330,856	11,923,481	345,546,677
1927	366,781,394	11,671,018	260,735,498
1928	332,224,233	10,785,315	229,998,680
Totals	$5,054,251,959	$676,192,886	$3,050,028,783

CHAPTER TWO

FUELS

Among the most important mineral products of California are its fuels. This subdivision includes coal, natural gas, and petroleum, the combined values of which made up practically 76 per cent of the state's entire mineral output for the year 1928.

There are deposits of peat known in several localities in California, small amounts of which are used as a fertilizer, and in stock-food preparations, but none has yet been recorded as utilized for fuel.

Comparison of values during 1927 and 1928 is shown in the following table:

	1927		1928		Increase+ Decrease—
Substance	*Amount*	*Value*	*Amount*	*Value*	*Value*
Coal	.....	.....	582 tons	$3,442	.....+
Natural gas	244,686,940 M cu. ft.	$20,447,294	260,887,116 M cu. ft.	22,260,947	$1,813,653+
Petroleum	231,195,774 bbls.	260,735,498	231,811,465 bbls.	229,998,680	30,736,818—
Unapportioned	.....	5,100	.....	.....	.....
Total value		$281,187,892	.....	$252,263,069	.....
Net decrease					$28,924,823

COAL

Bibliography: State Mineralogist Reports VII, XII–XV (inc.), XVII, XIX–XXI (inc.). U. S. Geol. Surv., Bulletins 285, 316, 431, 471, 581; Ann. Rept. 22, Pt III.

Coal produced in California in 1928 totaled 582 short tons valued at $3,442, being credited to Amador, Contra Costa and Shasta counties. There was a single producer in each. The Amador and Contra Costa coal was consumed by the local market and also used on the property for camp purposes, power and forge, to carry on regular operations and development work, while part of the Shasta County coal was shipped to the Pacific Gas and Electric Company gas works at Marysville for testing the manufacture of gas.

Total Coal Production of California.

The very considerable output of coal in the years previous to 1883 was almost entirely from the Mount Diablo district, Contra Costa County. Later the Tesla mine in Corral Hollow, Alameda County, was an important producer for a few years. Stone Canyon, Monterey County, was also an important producer for a short time, and there has been some coal shipped from properties in Amador, Fresno, Orange, Riverside and Siskiyou counties. The following tabulation gives the annual tonnages and values, according to available records:

Coal Output and Value by Years.

Year	Tons	Value	Year	Tons	Value
1861	6,620	$38,065	1896	70,649	$161,335
1862	23,400	134,550	1897	87,449	196,255
1863	43,200	248,400	1898	143,045	337,475
1864	50,700	291,525	1899	160,941	420,109
1865	60,530	348,048	1900	176,956	535,531
1866	84,020	483,115	1901	150,724	401,772
1867	124,690	716,968	1902	88,460	248,622
1868	143,676	826,137	1903	93,026	265,383
1869	157,234	904,096	1904	79,062	376,494
1870	141,890	815,868	1905	46,500	144,500
1871	152,493	876,835	1906	24,850	61,600
1872	190,859	1,097,439	1907	23,734	55,849
1873	186,611	1,073,013	1908	18,496	55,503
1874	215,352	1,238,274	1909	49,389	216,913
1875	166,638	958,169	1910	11,033	23,484
1876	128,049	736,282	1911	11,047	18,297
1877	107,789	619,787	1912	14,484	39,092
1878	134,237	771,863	1913	25,198	85,809
1879	147,879	850,304	1914	11,859	28,806
1880	236,950	1,362,463	1915	10,299	26,662
1881	140,000	805,000	1916	4,037	7,030
1882	112,592	647,404	1917	3,527	7,691
1883	76,162	380,810	1918	6,343	16,149
1884	77,485	309,950	1919	2,983	8,203
1885	71,615	286,460	1920	2,078	5,450
1886	100,000	300,000	1921	12,467	63,578
1887	50,000	150,000	1922	27,020	135,100
1888	95,000	380,000	1923	1,010	5,090
1889	121,280	288,232	1924	1,425	8,800
1890	110,711	283,019	1925	730	3,880
1891	93,301	204,902	1926	1,100	5,000
1892	85,178	209,711	1927	*	
1893	72,603	167,555	1928	782	4,542
1894	59,887	139,862			
1895	79,858	193,790	Totals	5,209,192	$23,107,900

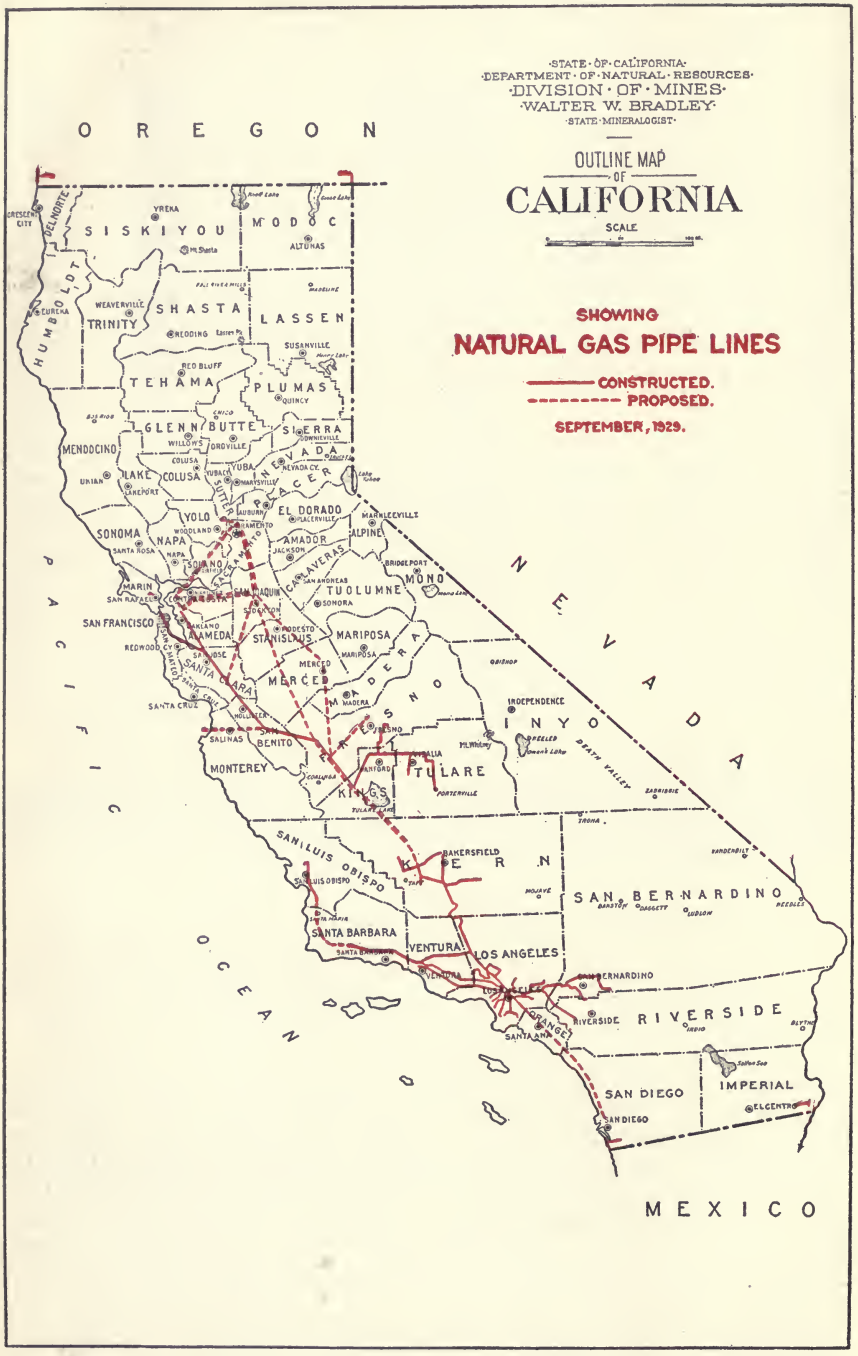
* Under 'Unapportioned.'

The tonnages in the above table for the years 1861–1886 (incl.) are taken from the U. S. Geological Survey, "Mineral Resources of the U. S., 1910," p. 107. The values assigned for the years previous to 1883 are those given by W. A. Goodyear (Mineral Res., 1882, pp. 93–94), being an average of $5.75 per ton. From 1887 to date the figures are those of the California State Mining Bureau.

NATURAL GAS

Bibliography: State Mineralogist Reports VII, X, XII, XIII, XIV, Bulletins 3, 16, 19, 69, 73, 89. Monthly Summary, Oil & Gas Supervisor, Dec., 1919; Aug., 1922; Mar., 1923; Mar. and Apr., 1926.

Statistics on the production of natural gas in California are in a considerable degree difficult to arrive at, as much of it that is utilized directly at the wells for heating, lighting, and driving gas engines is not measured. Hence, it is necessary to approximate the output of many of the operators in the oil fields, estimated on the number of lights, and on the number and horsepower of gas engines and steam boilers thus operated. The figures here given are for gas utilized locally and also that sold for distribution to consumers; and we consider are not over-estimated, particularly in the six oil-producing counties. It must be remembered that some of our important oil fields are removed many miles from the site of any other industry, and that the gathering of small amounts of gas and transporting it for any consider-


STATE OF CALIFORNIA
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF MINES
WALTER W. BRADLEY
STATE MINERALOGIST
OUTLINE MAP OF
CALIFORNIA
SCALE
SHOWING
NATURAL GAS PIPE LINES
CONSTRUCTED.
PROPOSED.
SEPTEMBER, 1929.
OREGON
NEVADA
MEXICO
PACIFIC OCEAN
SISKIYOU
MODOC
SHASTA
LASSEN
TRINITY
TEHAMA
PLUMAS
GLENN
BUTTE
SIERRA
MENDOCINO
LAKE
COLUSA
YUBA
NEVADA
PLACER
EL DORADO
YOLO
SONOMA
NAPA
AMADOR
ALPINE
SOLANO
MARIN
SAN FRANCISCO
CALAVERAS
TUOLUMNE
MONO
ALAMEDA
STANISLAUS
MARIPOSA
SAN MATEO
SANTA CLARA
MERCED
MADERA
INYO
SAN BENITO
MONTEREY
FRESNO
TULARE
KINGS
SAN LUIS OBISPO
KERN
SAN BERNARDINO
SANTA BARBARA
VENTURA
LOS ANGELES
ORANGE
RIVERSIDE
SAN DIEGO
IMPERIAL

able distance may not always be profitable, nor is it often possible to have pipe-line facilities available to handle the gas accompanying the early gas production in newly developed fields. Wherever feasible, casing-head gas is used in driving gas engines for pumping and drilling, and in firing the boilers of steam-driven plants.

The most notable gas developments in California have been in the Elk Hills and Buena Vista Hills in Kern County, northeast of the Midway district; in the oil fields in the Los Angeles basin, Los Angeles and Orange counties; and in Ventura County, and during 1928 the bringing in of the Kettleman Hills field in Kings County.

The use of natural gas will be furthered in the industry of the state; first, by the construction of pipe lines to all of the principal cities in the state, and, second, by a law passed by the last legislature making the unreasonable waste of natural gas illegal. Heretofore all gas that could not be sold or used on the property was wasted, but now it has to be used or the well is closed in until such a time when it can be used.

Natural Gas Pipe Lines.

During the past twelve years more than 5000 miles of natural gas pipe lines have been laid in California. The latest project is the Pacific Gas and Electric Company, which will bring gas from Buttonwillow and Kettleman Hills into the cities of the San Francisco Bay area and the Sacramento and San Joaquin valleys.*

The following article from the Los Angeles *Times* [1] told of the amount of natural gas supplied by some of the oil fields of southern San Joaquin Valley.

"The blowout of the Milham Exploration Company's Elliott No. 1 wildcat on the north dome of the Kettleman Hills as a gasser rated at 20,000,000 cubic feet a day is pregnant with petroleum and gas possibilities. Breaking loose just at this time, when a gas pipe line up both sides of the San Joaquin Valley to the bay district is in blue-print form, it unveils a great industrial panorama.

"This well blew itself in Saturday, when drillers had proceeded to 7102 feet with a side-tracking job in an effort to get back to the old bottom of the hole—7236 feet, where a drill stem was twisted off several months ago just as the drillers were about to prepare for a production test in a couple of hundred feet of promising oil formation. They went back up, plugged the hole, drilled past the trouble, and were apparently at the top of the oil formation, when the gas got out of control while the crew was running in a string of pipe.

HIGH-GRADE PRODUCT

"The Elliott No. 1, which has been drilling since March, 1926, is on Sec. 2, 22–17, in Kings County, eighteen miles southeast of Coalinga. Yesterday it was reported to be blowing sand and high-gravity oil far above the derrick. There was reported to be considerable sand coming out, and it was said that the oil might test between 40 and 50 deg. gravity. The unusually high gravity might indicate that the district would have a tendency to yield more gas than oil.

"That it might be a tremendous gas field is indicated by the fact that the south end of the San Joaquin Valley is noted for its heavy gas pressures, the Elk Hills field, southeast of Bakersfield, being rated as one of the biggest gas fields in the country. One well in the Elk Hills is credited with having produced more gas than any other well in the world. Its initial flow was gauged at 180,000,000 cubic feet per day. Buttonwillow Ridge, near the town of Wasco, just now is being developed into a gigantic commercial gas field by the Milham Exploration Company, which drilled the Elliott wildcat.

GAS FOR MILLIONS

"The Kettleman Hills lie west and a little north from the old bed of Tulare Lake, and from there down to the Elk Hills there is a great basin which, test wells indicate, may eventually yield enough gas to furnish domestic and industrial gas for millions of inhabitants of the Pacific slope for decades to come.

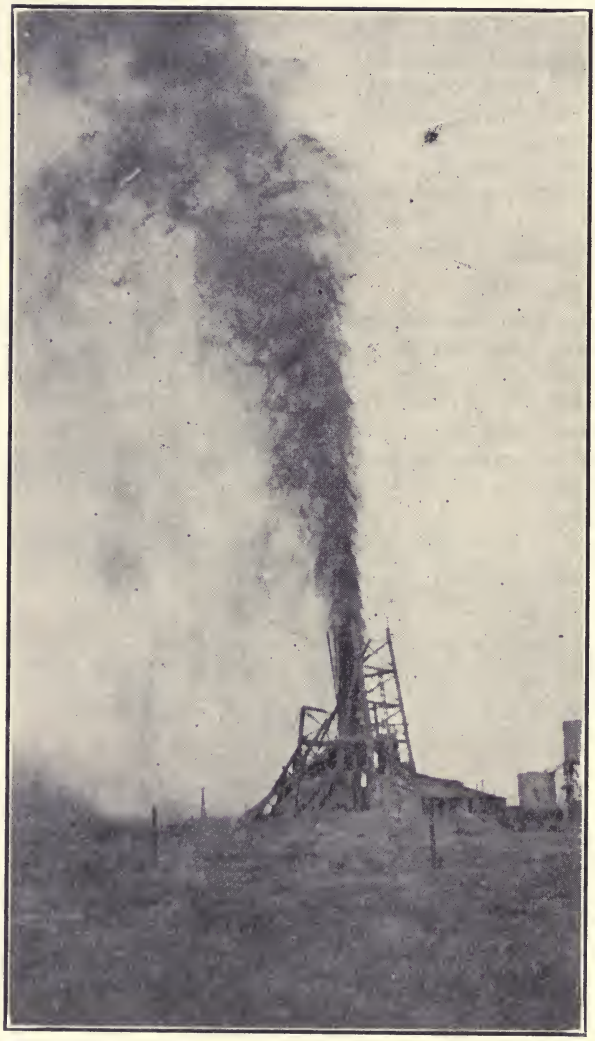
"Test wells drilled along the shore of the old dry lake bed have yielded considerable gas, several wells near there having in recent years been destroyed by gas blowouts and fires. Perhaps the principal reason why no more gas has been developed in the great basin along the west side of the San Joaquin Valley is that practically all of the operators who have drilled there have been hunting for oil instead of gas.

* Since the above was written the line has been completed, and natural gas is being delivered to consumers in the Bay District (November, 1929).

[1] Howard C. Kegley, Los Angeles *Times*, October 8, 1928.

PIPE LINE PROJECTED

"Within the week the major gas interests of this state applied to the State Railroad Commission to build a $16,000,000 gas-pipe line in the shape of a Y, from Ventura to Buttonwillow and from Buttonwillow up the west side of the valley to San Jose and up the east side to Tulare and Fresno, to connect with lines reaching from there to Sacramento. A short time ago permission was asked for a line to run from Goleta, Lompoc, Santa Maria and Santa Barbara.



Dudley Ridge Syndicate, Kings County, gas well throwing sand and water into the air. Photo by Walter Cameron.

"More than a year ago the writer forecast in these columns the ultimate construction of such a gas line to serve the San Francisco Bay district. The dawn of a great gas era in California now appears to justify the prediction that within the next few years great gas pipe lines from California oil and gas fields will carry industrial and domestic gas as far north as Portland and perhaps to Seattle, and will supply the street-lighting systems which will illuminate countless cities of California and Oregon and possibly Washington."

Production and Value.

There is rather a wide variation in prices quoted for natural gas because a considerable part is used directly in the field for driving gas engines and firing boilers, and is therefore not measured nor sold. Such companies as have placed a valuation on the gas that was thus used in 1928 gave from 3¢ to 25¢ per 1000 cu. ft. at the well. From the totals shown in the tabulation following herein, the average value for all fields in 1928 works out at approximately 8.6¢. Approximately 7000 cu. ft. of gas is equal to one barrel of oil in heating value, and is so accounted for by many operators. In driving gas engines, about 4000 cu. ft. per 24 hr. are consumed by a 25-h.p. engine, and 63,700 cu. ft. per day for heating a 70-h.p. steam boiler, which figures have been utilized in compiling this report, in those cases where gas was not metered.

Natural Gas 'Consumed,' or Utilized for Fuel, 1928

County	*M cu. ft.*	*Value*
Fresno	1,422,366	$151,061
Kern	35,107,062	1,916,797
Los Angeles	110,432,906	9,058,485
Orange	45,411,009	4,695,769
Santa Barbara	1,154,803	158,930
Ventura	67,058,513	6,196,549
Butte, Humboldt, King, Lake, Mendocino, Sacramento, San Joaquin and San Mateo *	300,457	83,356
Totals	260,887,116	$22,260,947

* Combined to conceal output of a single operator in each.

The above total for 1928 compared with 224,686,940 M cu. ft. valued at $20,447,294 in 1927. An important increase in quantity of natural gas utilized in 1928 was made by Los Angeles County, which showed 110,432,906 M cu. ft. worth $9,058,485 compared with 59,749,559 M cu. ft. worth $7,117,081 in 1927; and there were also increases in value, although a decrease in quantity used in Fresno and Orange counties, while Kern, Santa Barbara and Ventura showed a decrease in both quantity and value.

Natural Gas Production in California, Since 1888.

The production of natural gas in California by years since 1888 is given in the following table. The first economic use of natural gas in California was from the famous Court House well at Stockton, bored in 1854–1858. Beginning about 1883 and for several succeeding years, a number of gas wells were brought in around Stockton. Natural gas was known in a number of other localities, and occasionally utilized in a small way, notably at Kelseyville in Lake County, and in Humboldt County near Petrolia and Eureka, but there are no available authentic records of amounts or values previous to the year 1888. The most important developments in the commercial production of natural gas have been coincident with developments in the oil fields, by utilizing the casing-head gas as well as that from dry-gas wells.

Year	M cubic feet	Value	Year	M cubic feet	Value
1888	[a]12,000	$10,000	1909	1,148,467	$616,932
1889	[a]14,500	12,680	1910	10,579,933	1,676,367
1890	[a]41,250	33,000	1911	[a]5,000,000	491,859
1891	[a]39,000	30,000	1912	[a]12,600,000	940,076
1892	[a]75,000	55,000	1913	14,210,836	1,053,292
1893	[a]84,000	68,500	1914	16,529,963	1,049,470
1894	[a][b]85,080	79,072	1915	21,992,892	1,706,480
1895	[a][b]110,800	112,000	1916	28,134,365	2,871,751
1896	[a][b]131,100	111,457	1917	44,343,020	2,964,922
1897	[a]71,300	62,657	1918	46,373,052	3,289,524
1898	[a]111,165	74,424	1919	52,173,503	4,041,217
1899	115,110	95,000	1920	58,567,772	3,898,286
1900	40,566	34,578	1921	67,043,797	4,704,678
1901	120,800	92,034	1922	103,628,027	6,990,030
1902	120,968	99,443	1923	240,405,397	15,661,433
1903	120,134	75,237	1924	209,021,596	15,153,140
1904	144,437	91,035	1925	194,719,924	15,890 082
1905	148,345	102,479	1926	214,549,477	19,465,347
1906	168,175	109,489	1927	224,686,940	20,447,294
1907	169,991	114,759	1928	260,887,116	22,260,947
1908	842,883	474,584	Totals	1,830,262,681	$147,110,555

[a] Quantity, in part, estimated, where values only were reported.
[b] Includes natural CO_2 from a mine in Santa Clara County.

Gasoline from Natural Gas.

More or less gas usually accompanies the petroleum in the oil fields, and such gas carries varying amounts of gasoline. A total of 141 plants were in operation in 1928 recovering gasoline by compression or absorption from this 'casing-head' gas. After the gasoline is extracted the remaining 'dry gas' so far as practicable is taken into pipe lines, by which it is distributed to consumers, both domestic and commercial.

In certain of the oil fields, some of the casing-head gasoline is obtained as an incidental product to the compressing of the natural gas preliminary to its transmission to consuming centers through the gas pipe lines. Some concerns market the casing-head gasoline separately, others blend it with distillery gasoline, while others turn it into the oil pipe lines thus mixing this high-gravity gasoline with the crude oil for transportation to the refinery where it is later regained. A total of 546,941,272 gallons of casing-head gasoline valued at $39,191,165 was reported as made from all fields by 141 plants during 1928 compared with 489,798,683 gallons valued at $45,700,264 from 142 plants in 1927. It was distributed by counties as follows:

Natural-Gas Gasoline Recovered, 1928

County	*No. plants*	*Gallons*	*Value*
Fresno	1	339,447	$25,458
Kern	24	69,487,647	4,099,771
Los Angeles	67	296,827,951	21,865,268
Orange	30	85,814,989	7,209,131
Santa Barbara	3	9,504,699	807,899
Ventura	16	84,949,038	5,181,891
Other	--	17,500	1,750
Totals	141	546,941,272	$39,191,165

The usual recoveries of gasoline from natural gas vary from ½ gal. to 3 gal. per 1000 cu. ft. of gas handled, the average being about 1 gal. per 1000 cu. ft. The U. S. Bureau of Mines report by Knudsen [1] gives

[1] Knudsen, E. T., Statistical summary of California petroleum industry, 1928; U. S. Bureau of Mines, 1929, pp. 33–39.

the average recovery for 1928 as 1.475 gallons per 1000 cu. ft. of gas treated. His figures show the following production, by methods:

Natural-Gas Gasoline Production, 1928, by Methods

(Per U. S. Bureau of Mines)

Method	*Gallons*	*Recovery (Gal. per M cu. ft.)*
Oil absorption	363,161,220	1.409
Compression	3,438,806	1.138
Combination, compression and oil absorption	180,125,484	1.637
	223,528	----
Totals	546,949,038	1.475

PETROLEUM

Bibliography: State Mineralogist Reports IV, VII, X, XII, XIII, Bulletins 3, 11, 16, 19, 31, 32, 63, 69, 73, 82, 84, 89. Reports of Oil and Gas Supervisor 1915 to date (issued in monthly chapters since April, 1919). U. S. Geol. Surv., Bulletins 213, 285, 309, 317, 321, 322, 340, 357, 398, 406, 431, 471, 541, 581, 603, 621, 623, 653, 691; Prof. Papers 116, 117. "American Petroleum; Supply and Demand"; Amer. Petr. Inst., 1925.

The crude petroleum production in California for 1928 amounted to a total of 231,811,465 barrels of crude oil valued at $229,998,680 at the well.

This total of quantity is compiled from the monthly production reports filed by the operators with the State Oil and Gas Supervisor,

Elliott No. 1 well of Milham Exploration Co., the discovery well of the Kettleman Hills Oil Field, Kings County. Photo by Walter W. Bradley, July 20, 1929.

to which have been added figures for the output of a number of small operators in the old Los Angeles City Field not under the jurisdiction of the Supervisor.

The question of the value of the crude oil yield at the well is a difficult one to settle with exactitude principally because a large part of the output is not sold until after refining. The large refiners are also large producers of crude oil which they send direct from well to plant, hence much of the crude oil is not sold as such.

The value used in the statistical report of the State Mining Bureau and the Division of Mines and Mining from 1914 to 1927 (inc.) was

derived from an average of actual sales of crude oil of all grades in each field of the state and their average applied to the total yield of each respective field. The 1928 values, used by the Division of Mines, were obtained by using the production of crude oil by gravities produced in each field [1] and applying an average of current prices quoted by the Standard Oil Company for crude oil at the well.

Features of 1928.

The noteworthy features of the year 1928 in the oil industry were increased production in Los Angeles, Ventura and Santa Barbara counties; a decrease in all other major oil-producing counties; the bringing in of Kettleman Hills in November with a 60 degree gravity oil, adding Kings County as an oil-producing county. There were some increases in prices of crude oil, but not enough to make the average price equal that of 1927 or to offset the cut of that year.

Summarizing the data for the year, the State Oil and Gas Supervisor [2] presented the following figures:

Production.

"The total production of oil in the state for the last six months of 1928 was 118,818,659 barrels of oil and 64,887,350 barrels of water. The production of oil for the year 1928 was, therefore, 231,649,615 barrels, an increase of 603,842 barrels over that of 1927.

"The estimated closed-in production was increased during 1928 from 77,916 barrels daily in January to a maximum of 125,148 barrels daily in September and decreasing to 121,178 barrels daily in December.

Storage and Price Changes.

"The total crude and refined petroleum in storage in Pacific Coast territory at the end of 1928 was 141,057,009 barrels, according to the American Petroleum Institute. The increase in storage during the year amounted to 738,392* barrels compared with a decrease of 5,293,559 barrels during 1927. The total amount of crude and refined oil shipped to eastern ports during 1928 was 22,670,000 barrels, or 10,190,000 barrels less than the 1927 shipments. On August 15, in the Los Angeles Basin fields, prices of crude oil of 21 degrees gravity and above were increased 3 cents to 29 cents per barrel. In the Kern County fields, prices of oil of 22 degrees gravity and above were increased 1 cent to 32 cents per barrel. In the Coalinga field, the increase applied to oil of 20 degrees gravity and above. On October 2, in Kern County, prices of crudes under 14 degrees gravity were reduced 10 cents to 30 cents from 75 cents per barrel. On October 22 prices in the Kern River field were again reduced, all below 12 degrees gravity being priced at 45 cents per barrel and 12 degrees gravity and above priced at 50 cents per barrel, reduced from 75 cents.

Drilling and Development.

"During 1928, 1227 wells were reported to the State Oil and Gas Supervisor as ready to drill as compared with 1263 new wells in 1927. Four new fields were discovered in 1928, namely Kettleman Hills in Kings County, Ellwood in Santa Barbara County, the Fruitvale area on the outskirts of Bakersfield, Kern County, and the Lawndale field in Los Angeles County. Of these, by far the most important is the Kettleman Hills, probably the most remarkable field ever discovered in California, both because of its great area and because of the high gravity of the oil and great quantities of oil and gas it will undoubtedly produce."

---

[1] By courtesy of Standard Oil Co.

[2] Bush, R. D., Resume of Oil Field Operations of California in 1928; Cal. State Min. Bur., 14th Ann. Rep. of State O. & G. Super., No. 8, Feb., 1929.

* Storage at end of 1927 revised.

Production Figures.

The following table gives the production and value by counties for 1928 compared with the 1927 figures:

TABLE A

Production and Value of Crude Oil, by Counties

County	1927 Barrels	1927 Value	1928 Barrels	1928 Value
Fresno	7,202,285	$5,977,176	4,611,440	$3,524,985
Kern	51,570,412	58,738,699	44,096,638	36,803,054
Kings	*	*	198,784	576,474
Los Angeles	103,625,615	144,583,011	120,549,303	126,709,373
Orange	46,593,842	56,238,767	37,100,943	34,607,932
San Luis Obispo	16,709	12,531	15,140	12,869
Santa Barbara	2,173,887	1,630,415	3,078,103	3,409,923
Santa Clara	11,994	14,212	[a]	[a]
Ventura	19,996,841	23,536,282	22,143,318	24,311,194
Colusa, Kings, San Bernardino, San Mateo, Sonoma [a]	4,189	4,405	----------	----------
Colusa, San Mateo, Santa Clara [a]	----------	----------	17,796	42,921
Totals	231,195,774	$260,735,498	231,811,465	$229,998,680

[a] Combined to conceal output of a single operator in each.

The foregoing totals show the average price of $0.992 per barrel for the year 1928 as compared with $1.127 in 1927, $1.538 in 1926 and $1.442 in 1925.

TABLE B

Average Price of Oil per Barrel, by Counties, 1918–1928

County	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928
Fresno	$1.191	$1.293	$1.483	$1.068	$1.710	$1.162	$1.094	$0.815	$0.830	$0.764
Kern	1.252	1.350	1.714	1.211	.819	1.137	1.432	1.448	1.139	.835
Los Angeles	1.340	1.380	1.532	1.403	.971	1.239	1.429	1.645	1.115	1.051
Orange	1.412	1.860	2.138	1.175	.880	1.183	1.417	1.559	1.207	.935
San Luis Obispo	.905	1.040	1.400	.942	.600	.992	1.087	----------	----------	----------
Santa Barbara	1.235	1.125	1.575	1.011	.782	1.036	.914	.793	.750	1.108
Santa Clara	1.700	1.600	1.485	1.616	1.404	1.921	1.634	----------	----------	----------
Ventura	1.480	1.635	2.507	1.785	1.138	1.334	1.710	1.512	1.177	1.098
State average	$1.278	$1.409	$1.726	$1.249	$0.923	$1.200	$1.422	$1.538	$1.127	$0.992

For several years previous to 1919, the state average value per barrel at the well for crude oil as determined by the statistical returns was noted to practically coincide with the quotations during the same years for 23° gravity oil in the San Joaquin Valley fields. In 1919 and since, the average values have worked out at figures corresponding to quotations up to, in one year as high as 28° oil, due to the large yield of high-gravity oils from the new fields in the Los Angeles-Orange counties area.

TOTAL PETROLEUM PRODUCTION OF CALIFORNIA

The presence of oil seepages and springs in Los Angeles and Ventura counties was known and utilized in a small way early in the history of California. Some also was shipped to refineries at San Francisco from Santa Barbara and Humboldt counties. In the light of present-day developments, the following reference to the previous year's production

of oil and its future prospects as expressed by the San Francisco Bulletin of January 8, 1866, is strikingly prophetic even though skeptical:

"It is possible that the small quantity received (40,000 or 50,000 gallons in 1865) may be the forerunner of many millions which will, at some future time, lubricate the wheels of commerce and set a trade at work excelling in variety any that has thus far been known on this coast. At present, however, we admit to being a little skeptical about the assumption of the astute Professor Silliman that California will be found to have more oil in its soil than all the whales in the Pacific Ocean."

According to Hanks,[1] in 1874 production amounted to 36 bbl. per day from natural flows in Pico Cañon (Newhall), and at Sulphur Mountain (Ventura County), the oil being of 32° gravity average.

[2] "Work was commenced in Pico Canyon in 1875 by drilling three shallow wells with spring pole, all of which yielded oil at depths of from 90 to 250 feet. Actual work of development commenced with steam machinery in 1877."

In 1877 Pico averaged 40–50 bbl. daily, and Ventura 80 bbl. daily. In 1878, there was some production (@ 60 bbl. per day, for a time) from wells in Moody Gulch, near Los Gatos, Santa Clara County, the oil being of 46° Baumé.

The first wells in the Coalinga, Fresno County, and Summerland, Santa Barbara County, fields were drilled in 1890, but Coalinga did not make its influence felt conspicuously on the state's annual output until 1903. The Summerland yield never has been large. The Salt Lake field near Los Angeles began production in 1894 and in 1897 reached over a million barrels annually.

In the Kern County fields, the first well was drilled in Sunset in 1891, Midway in 1900, McKittrick in 1892, Kern River in 1899. The Sunset-Midway district attained a yield of over 4,000,000 bbl. in 1909, and over 20,000,000 bbl. in 1910. Kern River field produced over 3,000,000 bbl. in 1901.

The first well in the Santa Maria-Lompoc group, Santa Barbara County, was drilled in 1901, and the district advanced to a yield of over 3,000,000 bbl. annually in 1905.

The Whittier-Fullerton field in Los Angeles and Orange counties became an important factor in 1902. The Montebello field, Los Angeles County, was the conspicuous addition in 1918-1919; and Elk Hills, Kern County, with Huntington Beach and Richfield, Orange County, in 1920. In 1921, the new fields added were Long Beach and Santa Fe Springs, Los Angeles County; in 1922, Torrance field in Los Angeles County, and Wheeler Ridge field in Kern County; but the production from the large number of new wells started in these new Los Angeles County fields did not reach its peak until August and September, 1923. Dominguez (Compton) came in during 1923; followed by Rosecrans and Inglewood in 1924. Ventura recorded important additions to its producing area in 1925 and 1926. Seal Beach, Orange County, and Mt. Poso, Kern County, were the new fields added in 1926; Round Mountain, Kern County, and Rincon, Ventura County, were the new fields added in 1927; with Potrero in Los Angeles County, Elwood in Santa Barbara County and Kettleman Hills in Kings County in 1928.

The effect of the advent of these various fields to the producing column will be noted in the tabulation herewith, by years:

[1] Hanks, Henry G., Report IV of State Mineralogist, p. 298, 1884.
[2] *Idem*, p. 301.

TABLE C

Total Petroleum Production in California.

Year	Barrels	Value	Year	Barrels	Value
To and inc. 1875	(a) 175,000	(b) $472,500	1903	24,340,839	$7,313,271
1876	12,000	30,000	1904	29,736,003	8,317,809
1877	13,000	29,250	1905	34,275,701	9,007,820
1878	15,227	30,454	1906	32,624,000	9,238,020
1879	19,858	39,716	1907	40 311,171	16,783,943
1880	40,552	60,828	1908	48,306,910	26,566,181
1881	99,862	124,828	1909	58,191,723	32,398,187
1882	128,636	257,272	1910	77,697,568	37,689,542
1883	142,857	285,714	1911	84,648,157	40,552,088
1884	262,000	655,000	1912	89,689,250	41,868,344
1885	325,000	750,750	1913	98,494,532	48,578,014
1886	(a) 377,145	(b) 870,205	1914	102,881,907	47,487,109
1887	678,572	1,357,144	1915	91,146,620	43,503,837
1888	690,333	1,380,666	1916	90,262,557	57,421,334
1889	303,220	368,048	1917	95,396,309	86,976,209
1890	307,360	384,200	1918	99,731,177	127,459,221
1891	323,600	401,264	1919	101,182,962	142,610,563
1892	385,049	561,333	1920	103,377,361	178,394,937
1893	470,179	608,092	1921	112,599,860	203,138,225
1894	783,078	1,064,521	1922	138,468,222	173,381,265
1895	1,245,339	1,000,235	1923	262,875,690	242,731,309
1896	1,257,780	1,180,793	1924	228,933,471	274,652,874
1897	1,911,569	1,918,269	1925	232,492,147	330,609,829
1898	2,249,088	2,376,420	1926	224,673,281	345,546,677
1899	2,677,875	2,660,793	1927	231,195,774	260,735,498
1900	4,329,950	4,152,928	1928	231,811,465	229,998,680
1901	7,710,315	2,961,102			
1902	14,356,910	4,692,189	Totals	3,007,636,011	$3,053,635,300

[a] U. S. G. S., Min. Res. of U. S., 1886, p. 440, for quantities to and including 1886.
[b] Values have been estimated for the years to and including 1886, after consulting a number of contemporaneous publications, including the Mining & Scientific Press, Reports of the State Mineralogist, and U. S. Reports. The figures for 1887 to date are from records of the State Mining Bureau.

Well Data.

The following table is compiled from the monthly statements issued by the American Petroleum Institute:

TABLE D

Wells Operated by Fields, 1927

Field	Wells producing Dec. 1927	Wells producing Dec. 1928	Wells completed during year	Daily initial output	Wells abandoned during year	Bbls. per well produced per day Dec. 1927	Bbls. per well produced per day Dec. 1928
Kern River	1,365	1,227	72	12,999	8	17.0	14.6
Fruitvale		3	4	2,940	1		438.3
Mount Poso	4	4	22	7,500	12	27.7	37.8
Round Mountain		2	14	6,021	3		40.5
McKittrick	302	287	6	475	9	16.3	17.4
Midway-Sunset	2,963	2,462	63	13,838	75	28.2	29.7
Elk Hills	227	210			4	105.5	91.6
Lost Hills-Bclridge	309	313	24	1,049	1	13.4	14.0
Coalinga	973	790	9	292	20	87.2	12.7
Kettleman Hills		1	1	4,000			3,756.0
Wheeler Ridge	30	34	4	252		32.9	24.1
Watsonville	6	7	1	20		9.7	9.0
Santa Maria	215	221	9	2,200	1	27.1	22.3
Summerland	91	89				1.4	1.4
Elwood-Goleta	7	7	4	15,471	13	33.0	1,570.7
Rincon	1	25	25	13,822	1	157.0	163.1
Ventura Avenue	106	141	41	76,488	5	482.2	359.5
Ventura-Newhall	507	521	8	498	16	11.7	10.8
Los Angeles-Salt Lake	331	319			7	4.8	4.5
Whittier	183	168			1	9.4	9.8
Fullerton (Brea-Olinda)	386	377	7	9,028	1	38.8	38.9
Coyote	210	207	4	585	7	66.0	60.7
Santa Fe Springs	317	318	38	142,530	26	102.4	306.4
Montebello	177	167	5	495	2	73.1	65.9
Richfield	256	269	18	5,480	14	84.5	64.0
Huntington Beach	574	554	54	10,714	65	104.2	89.5
Long Beach	636	844	245	339,168	55	170.4	225.0
Torrance	655	604	2	142	40	31.1	25.7
Dominguez	74	68	5	1,483	2	183.9	152.8
Rosecrans	117	103	2	612	13	72.8	67.7
Inglewood	226	221	8	2,929		135.2	124.0
Newport	5	4			16	3.0	7.5
Seal Beach	131	140	14	7,298	24	324.5	203.2
Potrero		2	2	2,200	1		337.0
Lawndale		2	1	1,100			253.0
Miscellaneous Drilling					70		
Totals	11,284	10,711	712	681,629	512	[1]54.1	[1]65.0

[1] State average.

Specific Gravity of Oils Produced.

The proportion of heavy and light oil produced in the various fields is shown in Table E, following, for which we are indebted to the Standard Oil Company. Under present practice, oil below 18° Baumé may be considered as largely refinable for fuel and lubricants, while the lighter oils yield varying amounts of the higher refined products with corresponding proportions of residuum and fuel oil. Specific gravities in California range from 8° Baumé in the Casmalia field, Santa Barbara County, to 56° Baumé in Ventura County and 60° in Kettleman Hills, Kings County.

California crude oils are all essentially of asphalt base, with a few notable exceptions. In the following localities are wells yielding crudes containing both asphalt and paraffine constituents: Oil City field, Coalinga; a few deep wells in East Side field, Coalinga; a considerable part of the Ventura County fields; Western Minerals area, south of Maricopa; Wheeler Ridge, Kern County.

TABLE E

Production of Light and Heavy Oil, by Fields, 1927

Field	*Under 18° (barrels*)*	*18° above (barrels)*	*Total (barrels)*
Kern River	5,071,284	----------	5,071,284
Mt. Poso	53,977	----------	53,977
Fruitvale	--------	133,433	133,433
Round Mountain	44,455	----------	44,455
McKittrick	1,805,485	----------	1,805,485
Midway-Sunset	7,712,486	19,601,607	27,314,093
Elk Hills	881,627	7,225,571	8,107,198
Lost Hills-Belridge	295,053	1,231,438	1,526,491
Coalinga	3,404,787	1,250,497	4,655,284
Kettleman Hills	--------	199,699	199,699
Wheeler Ridge	--------	329,485	329,485
Watsonville	22,010	----------	22,010
Santa Maria	984,746	1,056,753	2,041,499
Summerland	44,853	----------	44,853
Elwood-Goleta	--------	895,152	895,152
Rincon	--------	1,082,735	1,082,735
Ventura Avenue	--------	18,920,942	18,920,942
Ventura-Newhall	50,045	2,046,298	2,096,343
Los Angeles-Salt Lake	513,864	46,743	560,607
Whittier	41,374	570,752	612,126
Fullerton	330,942	5,412,102	5,743,044
Coyote	20,963	4,881,035	4,901,998
Santa Fe Springs	--------	16,093,931	16,093,931
Montebello	43,783	4,325,855	4,369,638
Richfield	247,938	6,550,735	6,798,673
Huntington Beach	765,610	18,876,668	19,642,278
Long Beach	715,053	61,752,050	62,467,103
Torrance	2,187,130	4,266,937	6,454,067
Dominguez	5,139	4,261,870	4,267,009
Rosecrans	--------	2,392,325	2,392,325
Inglewood	1,153,708	9,609,089	10,762,797
Newport	13,146	----------	13,146
Seal Beach	--------	12,436,371	12,436,371
Potrero	--------	107,380	107,380
Lawndale	--------	15,686	15,686
Totals	26,409,458	205,573,139	231,982,597

* Barrels of 42 gallons.

As previously noted by Bradley,[1] a decided change has taken place in the relative proportions of light and heavy crudes produced in California since 1920, taking 18° Baumé as the dividing line. This subject has also been covered in detail and with charts, by Collom and Barnes.[2]

A marked drop took place in the low-gravity yield from 1910 to and including 1914. From 1914, it remained almost stationary, with a slight drop in 1921, while the high-gravity yield has increased at a rapid rate since 1915. The proportions have been reversed from approximately 75% low—25% high in 1914 to 25%low—75% high in 1921; 10% low—90% high in 1923; 14% low—86% high in 1924–1928.

This has been an important factor in its effect upon the average price per barrel of the state's output in these years, as well as its effect upon the relative situation between production and consumption. It has been a fortunate development, in view of the increased demand for refinery products (gasoline in particular).

Oil in 'Storage.'

Field, refinery, pipe-line, and tank-farm stocks of crude and refined products in the Pacific Coast territory totaled 141,057,009 barrels[3]

[1] Bradley, W. W., Mineral Production of California in 1921; Cal. State Min. Bur., Report XVIII, p. 442, Sept., 1922.

[2] Collom, R. E., and Barnes, R. M., California Oil Production and Reserves; Cal. State Min. Bur., Ninth Ann. Rep. of State Oil and Gas Supervisor, Aug., 1923, pp. 5–23.

[3] Standard Oil Bulletin, February, 1929, p. 15.

December 31, 1928, as compared with 140,398,617 barrels on December 31, 1927. The total increase in stock for the year was 738,392 barrels.

	Dec. 31, 1928 (barrels)	*Dec. 31, 1927 (barrels) (revised)*
Heavy crude, heavier than 20° A. P. I., including all grades of fuel	101,306,108	94,907,147
Refinable crude, 20° A. P. I., and lighter	17,954,434	20,268,569
Gasoline	10,766,410	13,712,030
Naptha distillates	1,541,414	1,901,279
All other stocks	9,488,643	9,529,592
Totals, all stocks	141,057,009	140,318,617

Outlook for 1929.

An order for curtailing California's crude oil production to the extent of 143,118 barrels daily was issued by State Umpire F. C. Van Deinse on April 30, 1929, effective 7 a.m. Sunday, May 4. This order further provided that a new well may flow open for ten days and thereafter the curtailment in each well shall be in the ratio assigned for that district. The amount of the curtailment in the various fields is shown as follows:

"All northern California fields are cut to 10 per cent, and the same percentage applies to Elk Hills, Fruitvale, Kern River District, Lost Ridge, Belridge, McKittrick, Midway-Sunset, Round Mountain, Wheeler Ridge, West Coyote, Fullerton, East Coyote, Inglewood, Lawndale, Los Angeles-Salt Lake, Montebello, Newport Beach, Richfield, Rosecrans, Meyer and Upper zones at Santa Fe Springs, Santa Maria, Ventura Avenue, Newhall and Watsonville districts.

"Cuts to 75 per cent of maximum apply to Kettleman Hills, Kern Front and Nordstrom and Lower zones at Santa Fe Springs; Long Beach curtailment is 28.2, Alamitos Heights is 27.91 per cent, Dominguez 7 11/64 per cent, Elwood-Goleta 21.24 per cent, Huntington Beach 10.92 per cent, Potrero 30 per cent, Rincon 22.42 per cent, Seal Beach 27.91 per cent, Summerland 17.42 per cent, Torrance 18.58 per cent, and Whittier is 74.91 per cent."

Utilization of California's Crude Oil.

Most of the crude oil produced in California is sent to storage reservoirs at the tank farms near the oilfields and from these reservoirs by pipe line to the refineries, the larger ones of which are located in the vicinity of Los Angeles or on San Francisco Bay.

During 1928 the crude oil consumed in California, according to the U. S. Bureau of Mines,[1] was: 211,222,156 barrels sent to the stills at the refineries; intercoast foreign shipments accounted for 2,300,913 barrels; foreign shipments accounted for 5,718,939 barrels, while 15,831,707 barrels were either consumed as fuel, added to heavy crude stock or lost.

The production of petroleum products during 1928 is shown in the Table F.

[1] Knudsen, E. T., Statistical Summary of the California Petroleum Industry, 1928; U. S. Bureau of Mines, 1929, pp. 2, 3.

TABLE F

Commodity	*Amount in barrels*
Crude oil	231,982,597
Gas oil and fuel oils, including heavy crude below 20° [a]	151,462,797
Natural gas gasoline	13,022,596
Gasoline and engine distillate	66,951,257
Kerosene	8,377,448
Lubricants	2,399,582
Asphalt	3,372,582
All other finished products	2,438,184
Totals [b]	245,005,193

[a] Includes 15,831,707 barrels of crude used as fuel or added to stock of heavy crude.
[b] Includes 13,022,596 barrels of natural gas gasoline.

Proved Oil Lands.

The total proved oil land of the state is 128,651 acres, an increase during 1928 of 3520 acres. Of this amount 23,998 acres, being owned by federal, state and city governments, or for other reasons, is not assessable for the support of the Division of Oil and Gas. The acreage in 1928 was distributed by counties as follows:

TABLE H

Proved Oil Lands and Number of Wells in 1928

County	*Land (acres)*	*Number wells Dec. 31, 1928*
Fresno	14,630	942
Kern	82,915	5,215
Los Angeles *	11,053	3,380
Orange	6,923	1,417
Ventura	5,093	749
Santa Barbara	7,609	335
San Luis Obispo	308	6
Santa Clara	80	11
San Bernardino, Sonoma and Kings	40	9
Totals	128,651	12,064

* Not including the old Los Angeles city field.

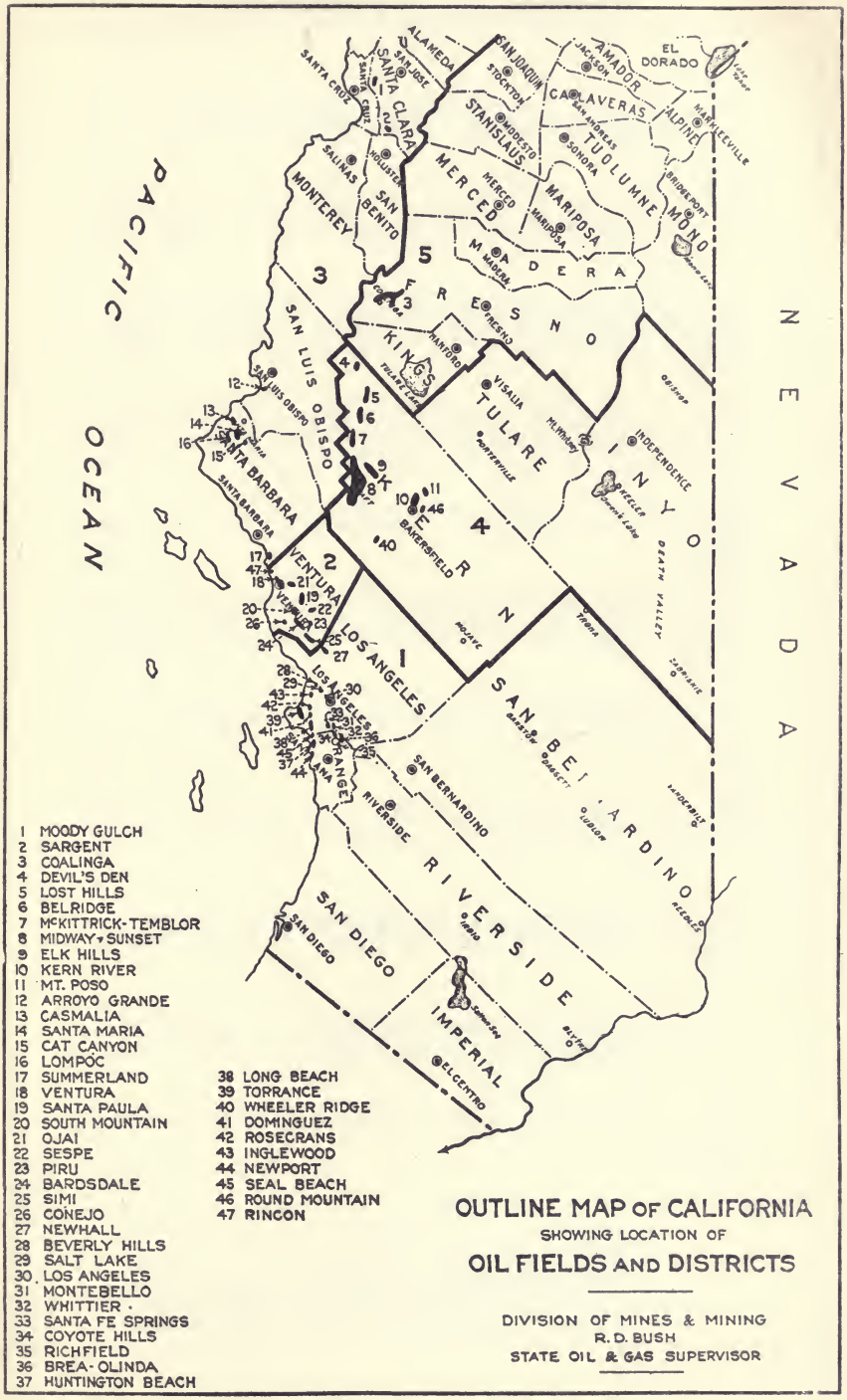

PACIFIC OCEAN
NEVADA
ALAMEDA
SANTA CLARA
SAN JOAQUIN
AMADOR
EL DORADO
CALAVERAS
STANISLAUS
TUOLUMNE
ALPINE
MONO
MERCED
MARIPOSA
MADERA
FRESNO
KINGS
TULARE
INYO
MONTEREY
SAN BENITO
SAN LUIS OBISPO
SANTA BARBARA
VENTURA
LOS ANGELES
SAN BERNARDINO
RIVERSIDE
SAN DIEGO
IMPRIAL
1 MOODY GULCH
2 SARGENT
3 COALINGA
4 DEVIL'S DEN
5 LOST HILLS
6 BELRIDGE
7 McKITTRICK-TEMBLOR
8 MIDWAY-SUNSET
9 ELK HILLS
10 KERN RIVER
11 MT. POSO
12 ARROYO GRANDE
13 CASMALIA
14 SANTA MARIA
15 CAT CANYON
16 LOMPOC
17 SUMMERLAND
18 VENTURA
19 SANTA PAULA
20 SOUTH MOUNTAIN
21 OJAI
22 SESPE
23 PIRU
24 BARDSDALE
25 SIMI
26 CONEJO
27 NEWHALL
28 BEVERLY HILLS
29 SALT LAKE
30 LOS ANGELES
31 MONTEBELLO
32 WHITTIER
33 SANTA FE SPRINGS
34 COYOTE HILLS
35 RICHFIELD
36 BREA-OLINDA
37 HUNTINGTON BEACH
38 LONG BEACH
39 TORRANCE
40 WHEELER RIDGE
41 DOMINGUEZ
42 ROSECRANS
43 INGLEWOOD
44 NEWPORT
45 SEAL BEACH
46 ROUND MOUNTAIN
47 RINCON
OUTLINE MAP OF CALIFORNIA
SHOWING LOCATION OF
OIL FIELDS AND DISTRICTS
DIVISION OF MINES & MINING
R. D. BUSH
STATE OIL & GAS SUPERVISOR

TABLE G. Production Statistics and Operating Data of California Oil Fields—1928

Field	January 1 to June 30						July 1 to December 31					
	Average number of producing wells—actual	Oil (bbls.)	Number of days producing	Production per well per day (bbls.)		Percentage of time wells produced	Average number of producing wells—actual	Oil (bbls.)	Number of days producing	Production per well per day (bbls.)		Percentage of time wells produced
				Oil	Water					Oil	Water	
DIST. 1—Beverley Hills	14	66,249	2,142	30.9	22.3	84.1	13	68,312	2,102	32.5	24.2	87.9
Brea-Olinda	399	2,926,456	67,984	43.0	14.5	93.6	393	2,861,797	70,040	40.9	14.6	96.9
Coyote Hills	204	2,476,011	36,077	68.6	35.9	97.2	201	2,377,196	35,968	66.1	37.2	97.3
Dominguez	77	2,322,576	13,268	175.1	50.9	94.7	74	1,991,176	12,990	153.3	67.3	95.4
[4]Huntington Beach	593	10,188,215	99,547	102.3	37.3	92.2	578	9,464,762	99,268	95.3	42.3	93.3
Inglewood	228	5,517,293	39,622	139.2	29.8	95.5	235	5,210,471	41,512	125.5	40.7	96.0
[1]Lawndale							1	20,810	176	118 2	0.4	95.7
Long Beach	680	26,854,650	115,545	232.4	75.9	93.4	802	35,663,810	138,463	257.6	75.0	93.8
Montebello	201	2,243,288	35,064	64.0	73.4	95.9	199	2,077,168	35,113	59.2	72.2	95.9
Newhall	77	31,807	13,812	2.3	3.9	98.6	77	31,854	13,898	2.3	3.7	98.1
Newport	4	4,413	505	8.7	13.5	69.4	5	10,828	852	12.7	3.5	92.6
[2]Potrero	1	34,141	103	331.5	21.9	56.6	[3]1	73,243	[3]208	352.1	30.7	100.0
Richfield	265	3,582,054	46,315	77.3	8.0	96.0	269	3,209,211	48,120	66.7	8.9	97.2
Rosecrans	113	1,260,141	19,290	65.3	56.9	93.8	106	1,133,482	18,478	61.3	57.5	94.7
Salt Lake	79	149,836	13,822	10.8	18.9	96.1	78	152,794	13,872	11.0	19.2	96.7
Santa Fe Springs	326	6,826,619	56,140	121.6	67.4	94.6	304	9,200,341	50,739	181.3	69.0	90.7
Seal Beach	146	7,107,440	24,226	293.4	121.5	91.2	138	5,311,436	23,582	225.2	166.5	92.9
Torrance	658	3,406,022	113,116	30.1	3.9	94.5	639	3,025,760	111,034	27.3	3.6	94.4
Whittier	177	307,592	31,658	9.7	25.6	98.3	177	303,192	32,177	9.4	26.1	98.8
Totals	4,242	75,304,803	728,236	103.4	39.8	94.3	4,290	82,187,643	748,592	109.8	43.5	94.8
DIST. 2—Bardsdale	132	141,226	22,884	6.2	.9	95.3	123	137,544	22,442	6.1	1.1	99.2
Conejo	12	300	720	.4	8.3	33.0	15	1,078	2,195	.5	2.6	79.5
Ojai	70	34,556	10,878	3.2	1.9	85.4	70	36,878	11,715	3.1	1.6	91.0
Piru	87	68,912	12,577	5.5	3.3	79.4	91	84,877	13,962	6.1	2.6	83.4
Rincon	12	342,913	1,234	277.9	16.0	56.5	23	761,301	3,681	206.8	23.4	87.0
Santa Paula	29	12,786	3,975	3.2	1.5	75.3	27	11,191	4,450	2.5	1.5	89.6
Sespe	26	30,327	3,478	8.7	.1	73.6	23	27,371	3,407	8.0	.1	80.5
Simi	53	21,399	7,689	2.8	.9	79.7	51	21,155	8,024	2.6	1.2	85.5
South Mountain	94	705,801	12,585	56.1	.3	73.6	83	699,428	13,410	52.2	.3	87.8
Ventura	133	9,279,095	20,839	445.3	45.7	86.1	149	9,725,180	22,995	422.9	45.7	83.9
Totals	648	10,637,315	96,859	109.8	11.1	82.1	655	11,506,003	106,281	108.3	11.7	88.2

[1] Commercial production in 1928.
[2] Started producing in March.
[3] Two wells on production in December, 1928.
[4] See page 37.

TABLE G. Production Statistics and Operating Data of California Oil Fields—1928—Continued

Field	January 1 to June 30						July 1 to December 31					
	Average number of producing wells—actual	Oil (bbls.)	Number of days producing	Production per well per day (bbls.)		Percentage of time wells produced	Average number of producing wells—actual	Oil (bbls.)	Number of days producing	Production per well per day (bbls.)		Percentage of time wells produced
				Oil	Water					Oil	Water	
DIST. 3—Arroyo Grande	7	7,230	1,111	6.5	0.3	87.2	6	7,910	1,092	7.2	0.4	98.9
Casmalia	11	12,503	1,992	6.3	79.9	99.5	11	10,901	2,006	5.4	75.2	99.1
Cat Canyon	41	564,326	6,876	82.1	3.8	92.1	40	452,030	6,641	68.1	2.4	90.2
[1]Elwood							2	859,560	286	3,005.5	3.0	77.7
Goleta	4	33,920	707	48.0	158.7	97.1	3	9,704	548	17.7	293.8	99.3
[2]Half Moon Bay	0	0	0	0	0	0	0	0	0	0	0	0
Lompoc	2	7,470	98	76.2	16.6	26.9	4	17,360	194	89.5	99.4	26.4
Moody Gulch	1	423	117	3.6	0	64.3	0	0	0	0	0	0
Santa Maria	171	551,333	25,485	21.6	41.7	81.9	170	513,219	25,624	20.0	40.6	81.9
Sargent	9	6,611	1,638	4.0	0	100.0	10	6,712	1,822	3.7	0	99.0
[2]Summerland	72	22,821	11,949	1.9	12.7	91.2	72	22,956	12,082	1.9	12.7	91.2
Totals	318	1,206,637	49,973	24.1	30.3	86.3	318	1,900,352	50,295	37.8	30.7	86.0
DIST. 4—Belridge-Lost Hills-Devils Den	271	746,037	47,160	15.8	34.8	95.6	282	769,401	48,698	15.8	30.5	93.9
Elk Hills	226	4,342,803	38,977	111.4	28.1	94.8	221	3,761,475	38,411	97.9	30.6	94.5
Kern River	1,339	2,953,980	230,711	12.8	61.0	94.7	1,229	1,940,117	214,757	9.0	63.9	95.0
McKittrick-Temblor	293	896,480	50,999	17.6	80.9	95.6	294	892,432	51,204	17.4	83.8	94.7
Midway-Sunset	2,678	13,773,178	453,232	30.4	17.4	93.0	2,518	13,430,292	436,315	30.8	17.3	94.2
Mt. Poso	2	16,596	204	81.4	1.2	56.0	6	36,448	400	91.1	1.1	36.2
Round Mountain	2	36,332	219	165.9	5.1	60.2	6	16,358	248	66.0	22.1	22.5
Wheeler Ridge	32	168,747	5,646	29.9	3.8	96.9	34	159,768	6,107	26.2	3.3	97.6
Kern County	2	18,132	140	129.5	0.5	38.5	4	138,062	432	319.6	18.8	58.7
Totals	4,845	22,952,285	827,288	27.7	34.9	93.8	4,594	21,144,353	796,572	26.5	35.5	94.2
DIST. 5—Coalinga	915	2,729,523	155,056	17.6	12.2	93.1	805	1,881,917	140,261	13.4	8.8	94.7
[2]Kings County	0	393	50	7.9	11.2	27.5	2	198,391	68	2,917.5	1.4	18.5
Totals	915	2,729,916	155,106	17.6	12.2	93.1	807	198,391	68	14.8	8.8	94.5
Grand totals	10,968	112,830,956	1,857,462	60.7	33.6	93.1	10,664	118,818,659	1,842,069	64.5	35.2	93.8
[4]Huntington Beach	7	133,160	900									

[1] Started producing in July, 1928.
[3] Estimated.
[2] Milham Exploration Co. well commenced producing in October, 1928.
[4] The exact production for some wells could not be obtained and the following estimates were incorporated in the above figures.

CHAPTER THREE

METALS

Bibliography: Reports of State Mineralogist I–XXII (inc.). Bulletins 5, 6, 18, 23, 27, 36, 50, 57, 76, 78, 85, 92, 95. Spurr and Wormser, "Marketing of Metals and Minerals." See also under each metal.

The total value of metals production in California during 1928 was $16,497,749. The chief of these is, and always has been, gold; followed by copper, silver, quicksilver, tungsten, lead, platinum, and manganese. There was also a small production of antimony, tin and titanium.

There was no production of arsenic, cadmium, molybdenum nor zinc, which have in the past been on the active list. Deposits of ores of nickel and vanadium have also been found in the state; although there has yet been no commercial output of them. The above-noted total of this group is a net decrease of $1,493,092 from the 1927 total of $17,990,841, due mainly to decreases registered by gold, zinc and titanium, regardless of increases in copper, quicksilver and platinum.

California leads all states in the Union in her gold production and is credited with approximately 26% of the nation's yield in 1928. The precious metal is widely distributed through the state. Thirty-two of the fifty-eight counties reported an output in 1928 from either mines or dredges.

Copper, which is second in importance among the metals of the state, occurs in the following general districts: the Shasta County belt, which has been by far the most important; the Coast Range deposits, extending more or less continuously from Del Norte in the north to San Luis Obispo County in the south; the Sierra Nevada belt, starting in Plumas and running in a general southerly and southeasterly direction through the Mother Lode counties and ending in Kern; the eastern belt in Mono and Inyo counties, and the southern belt in San Bernardino, Riverside and San Diego counties.

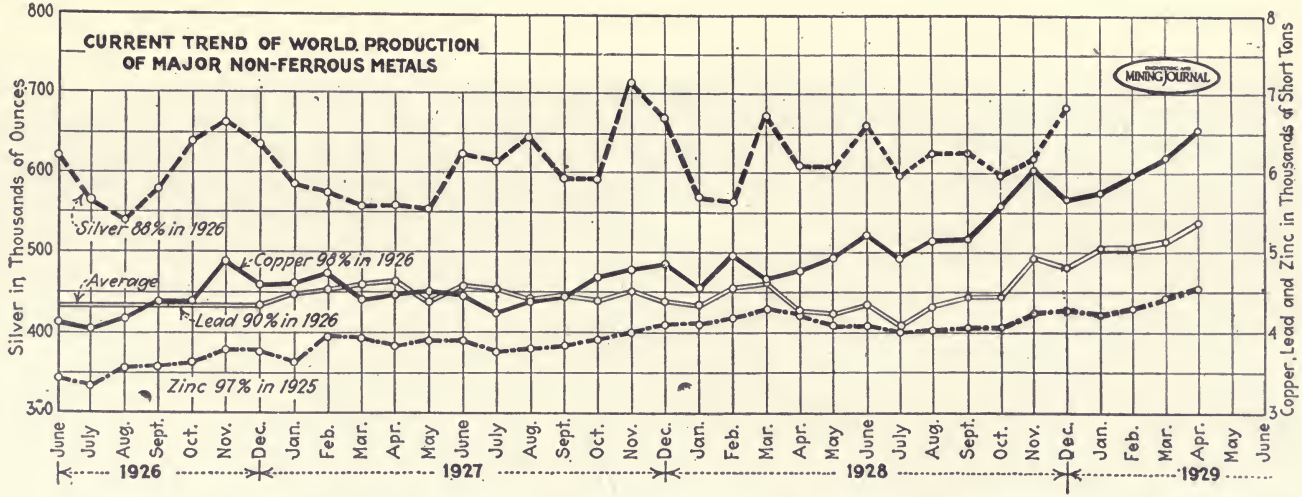
Silver is not generally found alone in the state, except notably in the Rand district, San Bernardino County; but is associated to a greater or less extent with gold, copper, lead and zinc.

Quicksilver has for many years been one of the state's staple products and California has supplied approximately 75% of the nation's output of this metal.

Tungsten is found in but few other localities of importance in the United States.

Large deposits of iron ore have long been known in several sections of the state, but for various economic reasons this branch of the mineral industry thus far has made only slight progress on the Pacific Coast.

Titanium is associated with some of California's iron deposits. This mineral is widely distributed through the United States, but the deposits of this state are among the few that are considered of commercial importance.



The curves are not to be considered as permanent records of production. They show merely the current trend in terms of daily output according to the latest estimates of the American Bureau of Metal Statistics. The figures represent production from countries that produce approximately 98 per cent of the world's copper, 97 per cent of the zinc, 90 per cent of the lead, and 88 per cent of the silver. The figures for lead on the new basis are not available for the individual months of 1926, and accordingly the horizontal line showing the monthly average reduced to a daily rate is shown. Delay in receipt of statistics from Mexico accounts for the failure of the silver curve to be up to date.—*June 15, 1929, Engineering and Mining Journal.*

Although the United States is a large consumer of certain metals, in fact the largest particularly of chromium and tin, our production from domestic sources is deficient. We have large reserves of low-grade chromite, manganese, tungsten, and antimony ores, but they do not fully supply our commercial needs.

A comparison of the 1928 output with that of the 1927 is afforded by the following table:

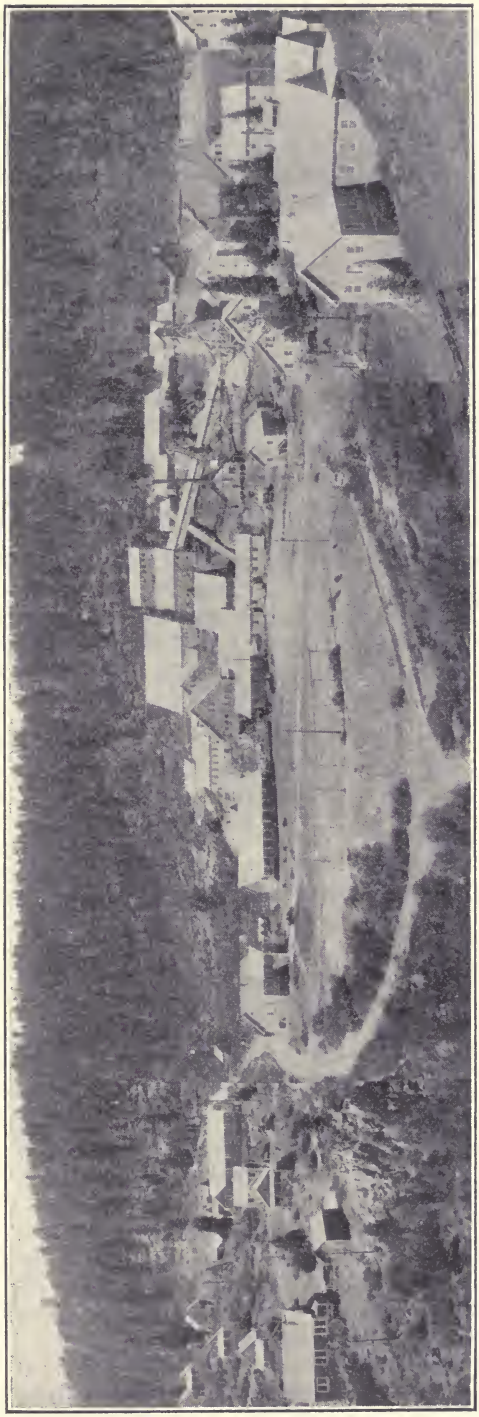
	1927		
Substance	*Amount*		*Value*
Antimony	*		*
Copper	27,354,316	lbs.	$3,582,885
Gold			11,671,018
Lead	2,748,440	lbs.	173,151
Platinum	139	fine oz.	10,749
Quicksilver	6,488	flasks	714,418
Silver	1,620,242	fine oz.	918,677
Zinc	8,625,005	lbs.	552,000
Unapportioned			[a] 367,943
Total value, 1927			$17,990,841

	1928			*Increase+ Decrease—*
Substance	*Amount*		*Value*	*Value*
Antimony	20	tons	$761	+[c]
Copper	25,162,304	lbs.	3,623,630	$40,745—
Gold			10,785,315	885,703—
Lead	1,882,795	lbs.	109,102	64,049—
Platinum	312	fine oz.	27,902	17,153+
Quicksilver	7,107	flasks	844,649	130,231+
Silver	1,478,771	fine oz.	865,081	53,659—
Zinc				552,000—
Unapportioned			[b] 241,579	126,364—
Total value, 1928			$16,497,749	
Net decrease				$1,493,092

* Under 'Unapportioned.'

[a] Includes antimony, iron ore, titanium and tungsten.

[b] Includes manganese ore, tin, titanium and tungsten.



Plant of Walker Mining Company near Spring Garden, Plumas County. Photo by Chas. V. Averill.

ALUMINUM

Bibliography: Report XVIII, p. 198. Bulletins 38, 67. U. S. Geol. Surv., Min. Res. of U. S.

To date there has been no commercial production of aluminum ore in California. Only a single authenticated occurrence of bauxite has thus far been noted in this state, being in Riverside County, southeast of Corona, but as yet undeveloped.

Minerals containing aluminum are abundant, the most widely distributed being the clays. There are only two, however, thus far of consequence commercially, in the production of the metal: bauxite (to which may be added the related hydrated oxides, hydrargillite and diaspore) and cryolite. Cryolite is found in commercial quantities only in south Greenland, and was formerly the only ore of aluminum used, being still employed as a flux in the extraction of the metal. Bauxite has been for some years, the most important source of alumninum and its salts. Its color varies from gray to red, according to the amount of iron present, the composition ranging usually between the following limits: Al_2O_3, 30%–60%; Fe_2O_3, 3%–25%; SiO_2, 0.5%–20%; TiO_2, 0.0-10%. Besides its reduction to the metal bauxite is also utilized in the manufacture of aluminum salts, refractory bricks, alundum (fused alumina) for use as an abrasive, and in the refining of oil. The most important producing countries, both of bauxite and the metal, are the United States and France, the former yielding more than 60 per cent of the world's output. In 1913 Frence led.

ANTIMONY

Bibliography: State Mineralogist Reports VIII, X, XII–XV (inc.), XVII, XXII. Bulletins 38, 91.

During 1928 in California there was mined and sold a total of 20 tons of antimony ore calculated at 45% antimony valued at $761 by four producers, one in Kern County and three in San Bernardino County. The Kern County ore ran from 28% to 39% antimony and the San Bernardino shipments from 40% to 79% antimony. There now is a smelter in Los Angeles handling antimony ore and most of the California producers ship their ore there for treatment.

Production of antimony in California has been irregular, and small in amount except during 1915–17 when the high war-time prices permitted American producers, for a short period, to compete with Chinese antimony. The principal commercial production of antimony in California has come from Kern, Inyo and San Benito counties, and other occurrences have been noted in Nevada, Riverside and Santa Clara counties. The commonest occurrence is in the form of the sulphide, stibnite; but in the Kernville and Havilah districts in Kern County there were notable deposits of the native metal, being among the few localities of the world where native antimony has been found. There was a small production reported from San Benito County and development work on properties both in Kern and San Benito counties.

California producers claim they can not operate profitably unless the price of antimony be above 12 cents per pound. During most of 1925 and 1926 the price was up, at times as high as 23¢, and as a consequence

there was some revival of antimony mining in California. Present New York quotations (September, 1929) are around 8¾¢ per pound for Chinese brands. China is the principal world source of antimony.

The antimony market (New York being the chief center) is recognized as one of the most unstable of the metal markets. As the world's requirements for antimony are comparatively small, the prices react sharply if an extra quantity of the metal be thrown onto the market, and the trade becomes so cautious that the market may disappear altogether, causing production to fall off rapidly.

Pure antimony metal and manufactured antimony compounds are of considerable importance as pigments in the ceramic industry. The most important use of the metal, commercially, is in various alloys, particularly type-metal (with tin and lead), babbitt (with tin and copper), and britannia metal (with tin and copper). An alloy of 6% antimony and 9.4% lead is being extensively used in making battery plates for storage batteries for automobiles, airplanes, and radio apparatus.

Antimony Production in California, by Years.

The production of antimony ore in California by years since 1887 has been as follows:

Year	Tons	Value	Year	Tons	Value
1887	75	$15,500	1901	50	$8,350
1888	100	20,000	1902		
1889			1915	510	35,666
1893	50	2,250	1916	1,015	64,793
1894	150	6,000	1917	158	18,786
1895	33	1,485	1918		
1896	17	2,320	1925	*26	770
1897	20	3,500	1926		
1898	40	1,200	1927	20	590
1899	75	13,500	1928	20	761
1900	70	5,700	Totals	2,429	$201,171

*Annual details concealed under 'Unapportioned.'

ARSENIC

Bibliography: Report XVIII. Bulletin 67. U. S. G. S., Min. Res. of U. S.

Arsenic is found in a number of localities in California in the mineral arsenopyrite (FeAsS), which is frequently gold bearing; and in scorodite ($FeAso_4+2H_2O$), an oxidation product of arsenopyrite. The occurrence of realgar (AsS) has also been noted. The principal source of the arsenic of commerce in the United States has been as a by-product from the metallurgical treatment of copper, gold, and lead ores. It is usually recovered in the form of the tri-oxide, or 'white arsenic,' for which there is a demand for the preparation of insecticides, for use in agriculture and horticulture, and especially against the cotton-boll weevil in the southern states.

Except for a small output in 1924, there has been no commercial recovery of arsenic from Californian ores. There having been only a single operator, the figures are concealed under the 'Unapportioned' item.

BERYLLIUM

Bibliography: Eng. & Min. Jour.-Press, Vol. 118, No. 8, p. 285, Aug. 23, 1924.

Beryllium is a metal resembling aluminum closely in its chemical character, and has a specific gravity of 1.85. Several alloys have been prepared experimentally, of which copper-beryllium has received the most attention. The addition of 5% beryllium produces a golden-yellow alloy. The compounds of beryllium at present used commercially are the nitrate and oxide. The nitrate is used by incandescent mantle manufacturers to harden the thorium oxide skeleton, and the oxide has been added to materials being used for the manufacture of abrasive compounds and in dental cements. Beryllium sulphate has been used to some extent in medical research.

There are a number of beryllium materials, but none have been found in commercial quantities, except beryl, which is a beryllium-aluminum silicate. The chief use at present for ground beryl is as an addition to porcelain products, where it reduces the coefficient of expansion. Beryllium metal is difficult to separate from aluminum.

Beryl occurs in California in the pegmatite dikes of the tourmaline gem district in northern San Diego and southwestern Riverside counties. Thus far there have been no commercial shipments of beryl except for gem purposes (the pink and aquamarine varieties).

BISMUTH

Bibliography: Bulletins 38, 67, 91. Am. Jour. Sci., 1903, Vol. 16.

Several bismuth minerals have been found in California, notably native bismuth and bismite (the ochre) in the tourmaline gem district in San Diego and Riverside counties, near Pala. Other occurrences of bismuth minerals, including the sulphide, bismuthinite, have been noted in Inyo, Fresno, Nevada, Tuolumne, San Bernardino, and Mono counties, but only in small quantities. The only commercial production recorded was 20 tons valued at $2,400, in 1904, and credited to Riverside County. Recovery of bismuth from blistered copper in the electrolytic refinery has been noted. In the United States, the principal recovery of bismuth is obtained as a by-product from the refining of lead bullion.

The uses of bismuth are somewhat restricted, being employed principally in the preparation of medicinal salts, and in low melting-point or cliché alloys. These alloys are utilized in automatic fire sprinkler systems in electric fuses, and in solders.

Present quotations for bismuth are around $1.85 per pound for the refined metal.

CADMIUM

Bibliography: U. S. Geol. Surv., Min. Res. of U. S., 1908, 1918.

During 1917 and 1918, cadmium metal was recovered by the electrolytic zinc plant of the Mammoth Copper Company in Shasta County. It was shipped in the form of 'sticks' and amounted to a total of several thousand pounds for the two years, the exact figures being concealed under 'Unapportioned.' That was the first, and thus far the only,

commercial production of cadmium recorded from California ore. Cadmium occurs there associated with zinc sulphide, sphalerite. Cadmium also occurs in the Cerro Gordo Mine, Inyo County, associated with smithsonite (zinc carbonate).

There are several cadmium minerals, but none of them occur in sufficient quantities individually to be profitable as distinct ores. The cadmium of commerce is derived as a by-product in the reduction of zinc minerals and ores, in nearly all of which it occurs in at least minute proportions, the average ratio being about 1 of cadimum to 200 of zinc. As cadmium behaves metallurgically much the same as zinc, it constitutes a fraction of 1 per cent of nearly all metallic zinc.

Cadmium is produced in the United States in two forms—metallic cadmium and the pigment, cadmium sulphide. The principal use of the metal is in low-melting point, or cliché alloys, and its salts are utilized in the arts, medicine, and in electroplating. The sulphide is employed as a paint pigment, being a strong yellow, which is unaffected by hydrogen sulphide gas from coal smoke. It is also employed in coloring glass and porcelain. Cadmium cliché metal is stated to be superior to the corresponding bismuth alloy, for making stereotype plates. Cadmium is also used in bronze telegraph and telephone wires, and gives some promise of being utilized in electroplating.

Present quotations for cadmium are 90¢ per pound for the refined metal.

COBALT

Bibliography: Report XIV. Bulletins 67, 91. U. S. G. S., Min. Res. of U. S., 1912, 1918.

Occurrences of some of the cobalt minerals have been noted in several localities in California, but to date no commercial production has resulted. Some of the copper ores of the foothill copper belt in Mariposa and Madera counties have been found to contain cobalt up to 3%. The most notable occurrence thus far found in this state is in the Mar-John Mine near Sheep Ranch, Calaveras County. Lenses of smaltite ($CoAs_2$), have been uncovered in the vein, there, and several tons taken out in the course of development work; but as yet there have been no commercial shipments.

The most important use of cobalt is in the manufacture of the alloy, stellite, in which it is combined with chromium, for making high-speed lathe tools, and non-tarnishing cutlery and surgeons' appliances. The metal is also used in electroplating, similarly to nickel; and the oxide, carbonate, chloride, sulphate and other salts are used in ceramics for coloring. Some of the organic salts of cobalt (acetate, resinate, oleate) are employed as 'driers' in paint and varnish.

The nominal quotation for cobalt is around $2.10 per pound for the refined metal.

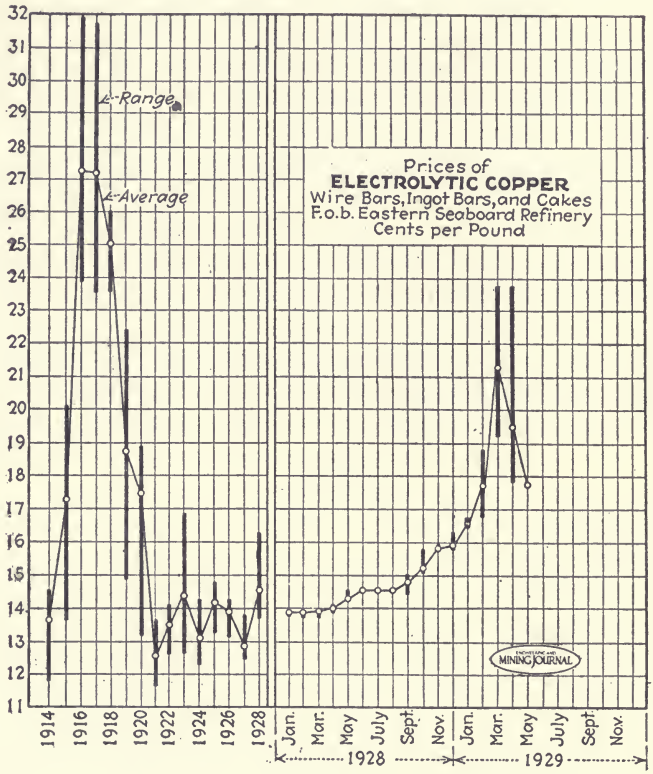
COPPER

Bibliography: State Mineralogist Reports VIII–XXII (inc.). Bulletins 23, 50, 91.

Copper is second to gold among the metals mined in California. The output for 1928 amounted to a total of 25,162,304 pounds of recoverable metal valued at $3,623,360. This was a slight increase in value over the 1927 figures, which were 27,350,316 pounds and $3,582,-

888. The average price of copper for 1928 was 14.4 cents per pound compared with 13.1 cents a pound in 1927.

As for several years past Plumas County ranks first in the production of copper for 1928 with an output of 21,141,121 pounds. Shasta comes second with 3,049,960 pounds and Trinity third with 660,147 pounds.



From Engineering and Mining Journal, June 15, 1929.

Distribution of the 1928 copper output by counties was as follows:

County	*Pounds*	*Value*
Amador	1,402	$202
Calaveras	150,911	21,731
El Dorado	1,074	155
Inyo	22,250	3,104
Madera	14,171	2,031
Plumas	21,141,121	3,044,321
Riverside	13,263	1,910
San Bernardino	106,351	15,314
Shasta	3,049,960	439,194
Trinity	660,147	95,060
Alpine, Butte, Fresno, Imperial, Mariposa, Nevada, Placer, Siskiyou, Sierra*	1,659	338
Totals	25,162,304	$3,623,360

* Combined to conceal output of a single operator in each.

Copper Production of the United States.

According to preliminary data issued by the U. S. Bureau of Mines,[1] the smelter production of primary copper from domestic

[1] U. S. Bureau of Mines, Press Bulletin, June 19, 1928.

sources during 1928 amounted to 1,825,900,395 pounds, an increase of approximately 8%. The value of smelter production increased approximately 3% in 1927. The average price of 3,097,000,000 pounds of copper delivered during the year, as reported to the Bureau of Mines by selling agencies, was 14.4¢ per pound.

COPPER IN 1928

"The year 1928 was marked by the largest production of refined copper from domestic and foreign sources ever made in the United States, according to the United States Bureau of Mines, Department of Commerce. In response to the heavy demand manifested in the latter part of the year, mine production was greatly increased. Smelter production is necessarily slower than mine production to respond to the demands of the market, but it was also increased largely and established a new peace-time record of smelter production from domestic ores. The increase in the price of electrolytic copper to a monthly average of 15.9 cents a pound in December, the highest since April, 1923, was instrumental in bringing forth the large increases noted. The increase in production, however, was not sufficient to offset the increase in deliveries, and stocks of refined copper at the end of 1928 were lower than they had been since the end of 1917. Blister stocks were larger than at the end of 1927, but total blister and refined stocks also were the lowest since 1917. Domestic withdrawals were indicated to be 1,608,538,878 pounds, exceeded only by those of 1918, 1,661,669,576 pounds. Imports of unmanufactured copper in 1928 were the highest on record and exports of metallic copper were exceeded only by the exports of 1917, when they were 1,125,647,336 pounds.

REFINED COPPER

"The total production of new refined copper in 1928 was 2,488,000,000 pounds, an increase of 162,000,000 pounds over that in 1927."

Primary and secondary copper produced by regular refining plants and imported, 1927–1928, in pounds:

	1927	*1928*
Primary:		
Domestic:[1]		
Electrolytic	1,520,076,181	1,607,120,026
Lake	195,135,199	179,104,311
Casting	3,740,819	5,573,050
	1,718,952,199	1,791,797,387
Foreign:[1]		
Electrolytic	605,748,329	693,787,036
Casting	1,063,181	2,023,356
Refinery production of new copper	2,325,763,709	2,487,607,779
Imports of refined copper	103,279,082	84,730,630
Total new refined copper made available	2,429,042,791	2,572,338,409
Secondary:		
Electrolytic	168,766,566	191,323,029
Casting	41,102,000	41,322,776
	209,868,566	232,645,805
Totals	2,638,911,357	2,804,984,214

[1] The separation of refined copper into metal of domestic and foreign origin is only approximate, as an accurate separation of the amounts at this stage of manufacture is not possible.

"In addition to their output of metallic copper the regular refining companies produced bluestone (hydrous copper sulphate) having a copper content of 11,326,000 pounds, as compared with 9,180,000 pounds in 1927."

STOCKS

Stocks of copper January 1, 1924, 1925, 1926, 1927, 1928 and 1929, in pounds.

Year	*Refined copper*	*Blister and material in process of refining*[1]
1924	264,000,000	432,000,000
1925	243,000,000	393,000,000
1926	124,000,000	432,000,000
1927	146,000,000	455,000,000
1928	171,000,000	401,000,000
1929	114,000,000	423,000,000

[1] The amounts stated in the last column in the table above do not include copper in stock at foreign smelters or in transit from foreign smelters to refineries in the United States."

Copper Production of California by Years.

Although some mining of copper ores in a small way had been done earlier, shipments in appreciable quantities began in 1861 and continued of importance up to the end of 1867, when a total of 68,631 tons (of 2376 pounds) of high-grade ores, and 847 tons of matte or 'regulus'[1] had been shipped to smelters at New York, Boston, and Swansea, Wales. The most important district at that time was Copperopolis and vicinity in Calaveras County, with some shipments also made from Mariposa, El Dorado, Fresno, and San Luis Obispo counties. From 1868 to 1882, the output was insignificant. There are wide discrepancies in the figures currently recorded for copper production previous to 1882 in which year the data of the U. S. Geological Survey began. The detailed statistics of the California State Mining Bureau began in the year 1894.

Amount and value of copper production in California annually since 1882 is given in the following tabulation:

Year	Pounds	Value	Year	Pounds	Value
1882	826,695	$144,672	1906	28,726,448	$5,522,712
1883	1,600,862	265,743	1907	32,602,945	6,341,387
1884	876,166	120,911	1908	40,868,772	5,350,777
1885	469,028	49,248	1909	65,727,736	8,478,142
1886	430,210	43,021	1910	53,721,032	6,680,641
1887	1,600,000	192,000	1911	36,838,024	4,604,753
1888	1,570,021	235,303	1912	34,169,997	5,638,049
1889	151,505	18,180	1913	34,471,118	5,343,023
1890	23,347	3,502	1914	30,491,535	4,055,375
1891	3,397,405	424,675	1915	40,968,966	7,169,567
1892	2,980,944	342,808	1916	55,809,019	13,729,017
1893	239,682	21,571	1917	48,534,611	13,249,948
1894	738,594	72,486	1918	47,793,046	11,805,883
1895	225,650	21,901	1919	22,162,605	4,122,246
1896	1,992,844	199,519	1920	12,947,299	2,382,303
1897	13,638,626	1,540,666	1921	12,088,053	1,559,358
1898	21,543,229	2,475,168	1922	22,883,987	3,090,582
1899	23,915,486	3,990,534	1923	28,346,860	4,166,989
1900	29,515,512	4,748,242	1924	52,089,349	6,823,704
1901	34,931,788	5,501,782	1925	46,968,499	6,669,527
1902	27,860,162	3,239,975	1926	33,521,544	4,693,014
1903	19,113,861	2,520,997	1927	27,350,316	3,582,888
1904	29,974,154	3,969,995	1928	25,162,304	3,623,360
1905	16,997,489	2,650,605			
			Totals	1,068,857,325	$171,476,749

GOLD

Bibliography: State Mineralogist Reports I to XXIII (inc.), (except III and VIII). Bulletins 36, 45, 57, 91, 92, 95. U. S. Geol. Surv., Prof. Paper 73.

Gold was the first, and, for many years, the most important single mineral product of California. Although now surpassed for a number of years in annual value by petroleum, and by cement beginning with 1920, it is still heads our metal list, and California continues to outrank all the other gold-producing states of the United States, including Alaska. In fact, at precent, California is producing approximately 26% of the gold mined in the entire United States.

While there is some renewal of activity in the development of gold placer properties, it has not yet become reflected in an increased yield of the metal. In fact, the 1928 figures show a decrease from the 1927 values.

[1] Brown, J. Ross, Mineral Resources West of the Rocky Mountains, p. 168, 1867.

The gold yield has decreased in recent years, not only in California but in the country as a whole. Meanwhile, the actual gold reserves (monetary stock on hand) of the United States has increased to such an extent that we now hold practically one-half of the world's stock.

The production of gold in California in 1928 totaled 521,739.59 fine ounces worth $10,785,315, being a decrease of 42,845.91 fine ounces from the 1927 yield. The deep or lode mines output accounted for $5,934,686 and the placers (mainly the dredges) produced $4,850,629. As the Division of Mines has never independently gathered the statistics of gold and silver production, these figures, as in former years, are published by cooperation with and through the courtesy of Mr. V. C.

New steel headframe at Kennedy Mine, Jackson, Amador County. Photo by Walter W. Bradley, July 30, 1929.

Heikes of the Division of Minerals and Statistics, U. S. Bureau of Mines.

The largest gold production for 1928 is reported from Yuba County with an output of 111,474.23 fine ounces ($2,304,377); Amador County second with 108,211.10 fine ounces ($2,236,922); Nevada County third with 96,459.83 fine ounces ($1,994,002); Sacramento County fourth with 75,376.64 fine ounces ($1,558,173); followed by Sierra and Trinity counties in fifth and sixth places, respectively. With the exception of Amador exceeding Nevada County, the leading gold producers remain in the same order as in 1927. The gold from Yuba and Sacramento comes almost entirely from dredges, while that from Nevada and Amador counties comes mainly from the lode mines.

Distribution of the 1928 gold output by counties was as follows:

County	Value	County	Value
Alpine	$23	Nevada	$1,994,002
Amador	2,236,922	Placer	71,959
Butte	48,432	Plumas	332,634
Calaveras	162,372	Riverside	2,180
Del Norte	277	Sacramento	1,558,173
El Dorado	122,017	San Bernardino	91,717
Fresno	15,455	San Diego	2,671
Humboldt	1,788	San Luis Obispo	725
Imperial	25	Shasta	113,132
Inyo	10,781	Sierra	674,855
Kern	186,453	Siskiyou	85,717
Lassen	492	Stanislaus	195,683
Los Angeles	2,187	Trinity	402,694
Madera	3,580	Tuolumne	36,807
Mariposa	120,568	Yuba	2,304,377
Merced	310		
Mono	6,307	Total value	$10,785,315

The following quotation from the advance chapter of gold in 1928 by courtesy of Mr. V. C. Heikes of the U. S. Bureau of Mines, Department of Commerce:

"The value of the mine production of gold in California in 1928 was $10,785,315, or $885,703 less than in 1927. Lode mines yielded 55 per cent and placer mines 45 per cent of the total gold in 1928.

"Four counties produced more than $1,000,000 each in gold in 1928, namely, Yuba, with $2,304,377, largely from dredges; Amador, with $2,236,922, largely from lode mines; Nevada, with $1,994,002, mostly from lodes; and Sacramento, with $1,558,173, mostly from dredges. Other succeeding counties, in order of output of gold, were Sierra, Trinity, Plumas, Stanislaus, Kern and Calaveras.

"The yield of gold from placer mines ($4,850,629), according to the method worked, was divided as follows: Dredges, 91 per cent; surface, 4 per cent; drift, 3 per cent; and hydraulic, 2 per cent. Production of gold by the 24 dredges in 1928 was 19 per cent less than in the preceding year. Gold obtained by hydraulic mining in 1928 decreased 24 per cent compared with 1927, but the yield from drift and surface placers increased respectively.

"The output of gold from the lode mines ($5,934,686) in 1928 was $100,981 more than in 1927, the first increase recorded in the lode gold yield since that of 1924 over 1923. Gold ore and tailings sold or treated in 1928 yielded 93 per cent, copper ore and tailings 6 per cent, and silver ore 1 per cent of the total gold from lode mines. Amalgamation mills in 1928 recovered 77 per cent, cyanidation plants 13 per cent, and smelters 10 per cent of the lode gold output of the state.

"In 1928 there were 26 companies that produced more than 1000 ounces of gold each, and they contributed nearly 90 per cent of the total gold output of the state. Of the 26 larger companies, 6 produced more than 20,000 ounces each and 2 more than 50,000 ounces each; 8 of them operated 20 dredges, 1 operated a drift placer, 1 a silver mine, 2 operated copper mines, 14 operated gold lode mines, and 1 operated a plant treating gold tailings. The 10 largest gold-producing companies in California in 1928, in order of output, were the Yuba Consolidated Gold Fields (6 dredges), Natomas Co. of California (6 dredges), Empire Mines Co. (gold lode), North Star Mines Co. (gold lode), Kennedy Mining and Milling Co. (gold lode), Original Sixteen to One Mines Co. Inc. (gold lode), Argonaut Mining Co. (gold lode), Central Eureka Mining Co. (gold lode), Walker Mining Co. (copper mine), and the Capital Dredging Co. (2 dredges)."

Total Gold Production of California.

The presence of gold in stream gravels near Los Angeles was known and worked in a small way by the Indians, at least as early as 1841,[1] and possibly 1820.[2] On March 2, 1844, Don Manuel Castanares, deputy for California to the Congress of Mexico, reported[3] to his government that placers near Los Angeles had produced up to December, 1843, a total of 2000 ounces of gold dust, most of which had been sent to the United States mint at Philadelphia.

As the padres and the rancheros discouraged the quest of gold this early, small production caused no particular excitement. It was not until James W. Marshall's finding of gold nuggets in the tail-race of Sutter's saw mill on the American River, January 24, 1848, was heralded

[1] Hittell, T. H., History of California: Vol. II, p. 312, 1885.
[2] Bancroft, H. H., History of California: Vol. II, p. 417, 1886.
[3] Mercantile Trust Review of the Pacific, Vol. XIV, No. 2, p. 43, Feb. 15, 1925.

abroad that the great rush began, and California became a commonwealth of first rank almost over night. There are, however, no authentic data on gold production prior to 1848, other than occasional, scattered references such as above quoted.

The following table was originally compiled by Chas. G. Yale, of the Division of Mineral Resources, U. S. Geological Survey, but for a number of years statistician of the California State Mining Bureau and the U. S. Mint at San Francisco. The authorities chosen for certain periods were: J. D. Whitney, state geologist of California; John Arthur Phillips, author of "Mining and Metallurgy of Gold and Silver" (1867); U. S. Mining Commissioner R. W. Raymond; U. S. Mining Commissioner J. Ross Browne; Wm. P. Blake, Commissioner from California to the Paris Exposition, where he made a report on "Precious Metals" (1867); John J. Valentine, author for many years of the annual report on precious metals published by Wells, Fargo & Company's Express; and Louis A. Garnett, in the early days manager of the San Francisco refinery, where records of gold receipts and shipments were kept. Mr. Yale obtained other data from the reports of the director of the U. S. Mint and the director of the U. S. Geological Survey. The authorities referred to, who were alive at the time of the original compilation of this table in 1894, were all consulted in person or by letter by Mr. Yale with reference to the correctness of their published data, and the final table quoted was then made up.

The figures for 1903–1923 (inclusive), are those prepared by the U. S. Geological Survey; and since by the U. S. Bureau of Mines:

Year	Value	Year	Value
1848	$245,301	1889	$11,212,913
1849	10,151,360	1890	12,309,793
1850	41,273,106	1891	12,728,869
1851	75,938,232	1892	12,571,900
1852	81,294,700	1893	12,538,780
1853	67,613,487	1894	13,863,282
1854	69,433,931	1895	15,334,317
1855	55,485,395	1896	17,181,562
1856	57,509,411	1897	15,871,401
1857	43,628,172	1898	15,906,478
1858	46,591,140	1899	15,336,031
1859	45,846,599	1900	15,863,355
1860	44,095,163	1901	16,989,044
1861	41,884,995	1902	16,910,320
1862	38,854,668	1903	16,300,653
1863	23,501,736	1904	18,633,676
1864	24,071,423	1905	18,898,545
1865	17,930,858	1906	18,732,452
1866	17,123,867	1907	16,727,928
1867	18,265,452	1908	18,761,559
1868	17,555,867	1909	20,237,870
1869	18,229,044	1910	19,715,440
1870	17,458,133	1911	19,738,908
1871	17,477,885	1912	19,713,478
1872	15,482,194	1913	20,406,958
1873	15,019,210	1914	20,653,496
1874	17,264,836	1915	22,442,296
1875	16,876,009	1916	21,410,741
1876	15,610,723	1917	20,087,504
1877	16,501,268	1918	16,528,953
1878	18,339,141	1919	16,695,955
1879	19,626,654	1920	14,311,043
1880	20,030,761	1921	15,704,822
1881	19,223,155	1922	14,670,346
1882	17,146,416	1923	13,379,013
1883	24,316,873	1924	13,150,175
1884	13,600,000	1925	13,065,330
1885	12,661,044	1926	11,923,481
1886	14,716,506	1927	11,671,018
1887	13,588,614	1928	10,785,315
1888	12,750,000		
		Total value	$1,823,678,329

IRIDIUM (see under Platinum)

IRON ORE

Bibliography: State Mineralogist Reports II, IV, V, X, XII–XV (inc.), XVII, XVIII, XXI, XXII, XXIII. Bulletins 38, 67, 91. Am. Inst. Min. Eng., Trans. LIII. Min. & Sci. Press, Vol. 115, pp. 112, 117–122; Vol. 123, pp. 94–96, 113–114.

There was no commercial production of iron ore in California during 1928, although there was a tonnage utilized in the manufacture of paint pigments and which is credited to "mineral paint" in this statistical report. The iron ore (magnetite) mined during the past few years from beach sands was used as a foundry flux and in steel refining at open-hearth plants.

There are considerable deposits of iron ore known in California, notably in Shasta, Madera, Placer, Riverside, San Bernardino and Los Angeles counties, but production has so far been limited for lack of an economic supply of coking coal. Some pig-iron has been made, utilizing charcoal for fuel, both in blast furnaces and by electrical reduction; also, ferrochrome, ferromanganese, and ferrosilicon have been made in California.

Total Iron Ore Production of California.

Total iron ore production in California, with annual amounts and values, is as follows:

Year	Tons	Value	Year	Tons	Value
1881*	9,273	$79,452	1914	1,436	$5,128
1882	2,073	17,766	1915	724	2,584
1883	11,191	106,540	1916	3,000	6,000
1884	4,532	40,983	1917	2,874	11,496
1885			1918	3,108	15,947
1886	3,676	19,250	1919	2,300	13,796
1887			1920	5,975	40,889
1893	250	2,000	1921	1,970	12,030
1894	200	1,500	1922	3,588	18,868
1895			1923	3,102	18,665
1907	400	400	1924[a]	785	4,710
1908			1925[a]		
1909	108	174	1926[a]	5,272	26,000
1910	579	900	1927[a]		
1911	558	558	1928		
1912	2,508	2,508			
1913	2,343	4,485	Totals	71,805	$552,629

*Productions for the year 1881-1886 (inc.) were reported as "tons of pig iron" (U. S. G. S., Min. Res. 1885), and for the table herewith are calculated to "tons of ore" on the basis of 47.6% Fe as shown by an average of analyses of the ores (State Mineralogist Report IV, p. 242). This early production of pig iron was from the blast furnaces then in operation at Hotaling in Placer County. Charcoal was used in lieu of coke. Though producing a superior grade of metal, they were obliged finally to close down, as they could not compete with the cheaper English and eastern United States iron brought in by sea to San Francisco.

[a] Annual details concealed under 'Unapportioned.'

LEAD

Bibliography: State Mineralogist Reports IV, VIII–XV (inc.), XVII–XXII (inc.)

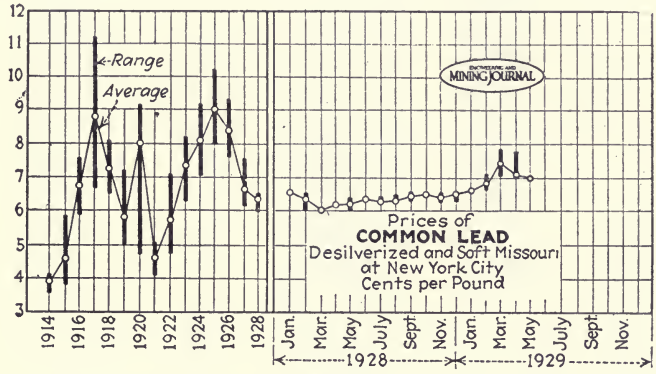
The production of lead in California in 1928 was 1,882,795 pounds of recoverable metal valued at $109,102 as compared with the 1927 figures, which were 2,748,440 pounds valued at $173,151. The average value of lead in 1928 was 5.8 cents; in 1927 was 6.3 cents; in 1926 was 8.0 cents.

As in the past, the principal output of lead was from the lead-silver ores of Inyo County.

Distribution of the 1928 lead output by counties was as follows:

County	*Pounds*	*Value*
Alpine	3,001	$174
Calaveras	2,817	163
Inyo	1,733,120	100,421
Riverside	99,097	5,747
San Bernardino	38,097	2,209
Shasta	4,400	255
El Dorado, Los Angeles, Nevada, Plumas, Siskiyou and Tulare*	2,263	133
Totals	1,882,795	$109,102

* Combined to conceal output of a single operator in each.



From Engineering and Mining Journal, June 15, 1929.

In 1928 the production of primary lead in the United States was about 624,000 short tons valued at $78,624,000, as shown by report of the United States Bureau of Mines,[1] this being a decline from the national production of 1927 of 668,320 short tons valued at $84,210,000, due to a decline in the average selling price of lead from 6.7¢ to 6.3¢.

[1] U. S. Bureau of Mines, Mineral Resources of the United States (Preliminary Summary).

Lead Production of California, by Years.

Statistics on lead production in California were first compiled by this Bureau in 1887. Amount and value of the output, annually, with total figures, to date, are given in the following table:

Year	Pounds	Value	Year	Pounds	Value
1877	[a] 7,836,000	$391,800	1904	124,000	$5,270
1878	8,640,000	328,320	1905	533,680	25,083
1879	4,502,000	191,335	1906	338,718	19,307
1880	4,200,000	215,460	1907	328,681	16,690
1881	6,680,000	325,316	1908	1,124,483	46,663
1882	[b] 4,000,000	196,800	1909	2,685,477	144,897
1883	[c] 3,400,000	145,520	1910	3,016,902	134,082
1884	3,200,000	120,512	1911	1,403,839	63,173
1885	2,000,000	80,900	1912	1,370,067	61,653
1886	2,000,000	93,400	1913	3,640,951	160,202
1887	[d] 1,160,000	52,200	1914	4,697,400	183,198
1888	900,000	38,250	1915	4,796,299	225,426
1889	940,000	35,720	1916	12,392,031	855,049
1890	800,000	36,000	1917	21,651,352	1,862,016
1891	1,140,000	49,020	1918	13,464,869	956,006
1892	1,360,000	54,400	1919	4,139,562	219,397
1893	666,000	24,975	1920	4,903,738	392,300
1894	950,000	28,500	1921	1,149,051	51,707
1895	1,592,400	49,364	1922	6,511,280	358,120
1896	1,293,500	38,805	1923	9,934,522	695,416
1897	596,000	20,264	1924	4,984,387	398,751
1898	655,000	23,907	1925	7,352,422	639,661
1899	721,000	30,642	1926	8,067,873	645,429
1900	1,040,000	41,600	1927	2,748,440	173,151
1901	720,500	28,820	1928	1,882,795	109,102
1902	349,440	12,230			
1903	110,000	3,960	Totals	184,694,659	$11,099,769

[a] Quantities for 1877–1881 (inc.) from C. E. Siebenthal, Mineral Resources of U. S. 1912, Part I, U. S. Geol. Survey, p. 339; and values for same years from quotations in Eng. & Min. Jour. of New York.
[b] Estimated.
[c] Quantities and values for 1883–1886 (inc.) from Mineral Resources of U. S. Geol. Surv., 1883–1886, respectively.
[d] Data from 1887 to date from reports of California State Mining Bureau.

MANGANESE

Bibliography: State Mineralogist Reports XII-XV (inc.), XVIII, XXII. Bulletins 38, 67, 76, 91. U. S. G. S., Bull. 427. Eng. & Min. Jour.-Press, Vol. 117, p. 545.

Manganese ore shipments in California during 1928 were made from Plumas and Riverside counties. The amount was placed under "unapportioned" to conceal the output of either producer.

These ores showed analyses of from 45% to 55% Mn and were utilized by plants for ferromanganese and for fertilizer.

Importations of foreign manganese ores to the United States in 1928, mainly from Brazil, amounted to a total of 635,486 long tons valued at $5,395,949, compared with 622,067 tons and $8,487,016 in 1927.

The Tariff Act of 1922 provides for an import duty of 1¢ per pound on the metallic manganese contained, for "manganese ore or concentrates containing in excess of 30 per centum of metallic manganese." The bulk of such ore is consumed in the large steel-producing centers of the eastern United States.

Much valuable research work has been done in recent years, particularly by companies operating in Montana and Virginia, in the beneficiation of manganese ores. The success of their processes appears assured. In reply to the recent suggestions of certain steel interests to have the manganese import duty removed, the manganese operators

have organized the American Manganese Producers' Association, which is working for retention of the tariff. Such retention will enable the domestic industry to grow and to further develop ore-dressing methods that will make available large tonnages of low-grade material not now marketable.

Manganese Ore Production in California, by Years.

Production of manganese ore in California began at the Ladd Mine, San Joaquin County, in the Tesla District in 1867. When shipments of this ore to England ceased late in 1874, upwards of 5000 tons had been produced by that property. For some years following that, the output was small. The tabulation herewith shows California's ouput of manganese ore, annually, since 1887, when the compilation of such figures was begun by the State Mining Bureau:

Year	Tons	Value	Year	Tons	Value
1887	1,000	$9,000	1909	3	$75
1888	1,500	13,500	1910	265	4,235
1889	53	901	1911	2	40
1890	386	3,176	1912	22	400
1891	705	3,830	1913		
1892	300	3,000	1914	150	1,500
1893	270	4,050	1915	4,013	49,098
1894	523	5,512	1916	13,404	274,601
1895	880	8,200	1917	15,515	396,659
1896	518	3,415	1918	26,075	979,235
1897	504	4,080	1919	11,569	451,422
1898	440	2,102	1920	2,892	62,323
1899	295	3,165	1921	1,005	12,210
1900	131	1,310	1922	540	7,650
1901	425	4,405	1923	690	10,620
1902	870	7,140	1924	1,115	25,785
1903	1	25	1925	832	19,450
1904	60	900	1926	235	4,700
1905			1927		
1906	1	30	1928	*	*
1907	1	25			
1908	321	5,785	Totals	87,511	$2,383,554

* Annual details concealed under 'Unapportioned.'

MOLYBDENUM

Bibliography: State Mineralogist Reports XIV, XVII. Bulletins 67, 91. U. S. Bur. of Min., Bulletin 111. Proc. Colo. Sci. Soc., Vol. XI.

Molybdenum is used as an alloy constituent in the steel industry, and in certain forms of electrical apparatus. Included in the latter is its successful substitution for platinum and platinum-iridium in electric contact-making and -breaking devices. In alloys it is used similarly to and in conjunction with chromium, cobalt, iron, manganese, nickel, tungsten, and vanadium. The oxides and the ammonium salt have important chemical uses.

The two principal molybdenum minerals are: the sulphide, molybdenite; and wulfenite, lead molybdate; the former furnishing practically the entire commercial output. Molybdenite is found in or associated with acidic igneous rocks, such as granite and pegmatite. The chief commercial sources have been New South Wales, Queensland and Norway, with some also from Canada; but the United States is now able to supply its own requirements.

The growing consumption of molybdenum by alloy-steel makers in the United States has been stimulated by the fact that molybdenum

alone of the steel-alloying metals can be produced commercially in the United States to an extent which avoids all necessity for importation. Another fact has been the marked adaptability of molybdenum steels to large-scale production of automobile and other parts.

The most important development of 1924-1925 was the elimination of ferromolybdenum from the market due to the substitution of calcium molybdate as the furnace addition by the entire alloy-steel industry. Calcium molybdate is stated to be not only easier and less costly to prepare, but it introduces the molybdenum into the steel bath in a much purer form, the resulting steel being superior to that made with ferromolybdenum.

Deposits of disseminated molybdenite are known in several localities in California, and in at least two places it occurs in small masses associated with copper sulphides. The only recorded commercial shipments of molybdenum ore in California were during the war 1916-1918. Some development work has been recently done on a high-grade deposit at the head of the Kaweah River, Tulare County.

The present quotations on ferromolybdenum are $1.25 per pound Mo, 50%–60% Mo, f. o b. shipping point.

Molybdenum Production of California, by Years.

California's production of molybdenum ore by years is summarized in the following tabulation:

Year	*Tons*	*Value*
1916	8	$9,945
1917	243	9,014
1918	*	300
Totals	251	$19,259

* 300 pounds of 90% MoS_2, concentrate.

NICKEL

Bibliography: State Mineralogist Reports XIV, XVII, U. S. G. S., Bulletin 640-D. U. S. Bureau of Standards, Circular 100.

Nickel occurs in the Friday Copper Mine in the Julian District, San Diego County. The ore is a nickel-bearing pyrrhotite, with some associated chalcopyrite. Some ore has been mined in the course of development work but not treated nor disposed of, as they were unable to get any smelter to handle it for them. Nickel ore has also been reported from other localities in California, but not yet confirmed.

Present quotations for nickel are around 35¢-36¢ per pound for the refined metal.

OSMIUM (see under Platinum)

PALLADIUM (see under Platinum)

PLATINUM

Bibliography: State Mineralogist Reports IV, VIII, IX, XII-XVIII. Bulletins 38, 45, 67, 85, 91, 92. U. S. Geol. Surv. Bulletins 193, 285. Trans. Am. Ins. Min. Eng., Vol. 47, pp. 217-218.

In California the platinum group metals are obtained as a by-product from placer operations for gold. The major portion of it comes from the dredges working in Butte, Sacramento, Stanislaus, Shasta and Yuba counties, with a small amount coming from the hydraulic and surface-sluicing mines of Del Norte, Humboldt, Siskiyou, and Trinity counties.

The production of platinum metals in California in 1928 totaled 357 ounces crude containing 312 fine ounces valued at $27,902 which was an increase over the 1927 figure of 139 fine ounces and $10,757. Of this amount 306 fine ounces or 98% came from the gold dredges. This metal came from a single producer in each of the following: Calaveras, Sacramento, Shasta, Stanislaus, Trinity, and Yuba counties; Yuba having the largest production. In addition to the above metal there was some platinum metal recovered but not sold in Butte County.

Of the above 312 fine ounces at least 35 fine ounces were iridium, 36 fine ounces osmium, 10 ruthenium and 2 palladium.

Most of the platinum refiners pay for the osmiridium on the basis of its iridium content. Crude 'platinum' is really a mixture of the metals of that group, and carries varying percentages of platinum, iridium, osmiridium or iridosmine, with occasionally some ruthenium and palladium. In the addition to the above-noted production, there is usually some platinum recovered as a by-product in the gold refinery of the mint, but which can not be assigned to the territory of its origin for lack of knowledege as to which lots of gold it belongs. Some platinum and palladium are also recovered in the electrolytic refining of blister copper.

Uses, Markets, and Consumption.

Besides its well known uses in jewelry, dentistry and for chemicalware, an important industrial development of recent years employs platinum as a catalyzer in the 'contact process' of manufacturing concentrated sulphuric acid. It is also necessary for certain delicate parts of the ignition systems in automobiles, motor boats and aeroplanes. Experiments have been made to find alloys which can replace platinum for dishes and crucibles in anlytical work, but so far with only slight success.

According to U. S. Bureau of Mines, Department of Commerce, the total consumption of platinum metals in the United States in 1928 was 187,287 fine ounces, an increase from that consumed in 1927, distributed as follows:

Platinum Metals Consumed In the United States as Reported by Refiners, 1927 and 1928, by Industries, In Troy Ounces

Industry	*Platinum*	*Palladium*	*Iridium*	*Others*	*Total*	*Per-centage of total*
1927						
Chemical	11,010	180	101	175	11,466	8
Electrical	14,905	2,491	1,618	121	19,135	13
Dental	7,504	12,194	153	----	19,851	13
Jewelry	86,036	3,706	4,059	329	94,130	63
Miscellaneous	3,176	312	305	1,311	5,104	3
Totals	122,631	18,883	6,236	1,936	149,686	100
1928						
Chemical	18,529	1,252	113	135	20,029	11
Electrical	21,316	9,150	1,525	2	31,993	17
Dental	10,993	12,270	167	10	23,377	12
Jewelry	93,468	4,965	3,260	815	102,508	55
Miscellaneous	5,431	2,136	963	850	9,380	5
Totals	149,674	29,773	6,028	1,812	187,287	100

STOCKS

At the end of 1928 stocks of platnium metals in the hands of refiners was 79,267 ounces, a decrease of 22 per cent as compared with stocks at the end of 1927.

Stocks of Platinum Metals in the Hands of Refiners in the United States, December 31, 1919–1928, in Troy Ounces

Year	Platinum	Palladium	Iridium	Others	Total
1919	29,228	10,235	3,359	610	43,432
1920	46,747	16,565	4,196	216	67,724
1921	38,514	21,042	4,991	3,113	67,660
1922	41,900	24,975	7,559	1,583	76,017
1923	36,554	26,266	5,208	2,697	70,725
1924	40,464	27,400	3,622	3,053	74,539
1925	44,024	26,740	3,720	4,609	79,093
1926	64,203	31,950	3,933	5,485	105,571
1927	68,757	24,313	4,617	4,369	102,056
1928	45,810	23,018	4,523	5,019	78,370

Prices.

The prices of all the metals in the platinum group fluctuated some during 1928, according to quotation.[1] The price of pure platinum started the year at $72 a fine ounce going to $85 by January 16 and closing the year at $74. Palladium varied from $51 to $42 a fine ounce, ending the year at $42 to $44; iridium started the year at $260 going to $450 in January and ended the year at $280 to $300.

Most of the platinum metals shipped to the United States during the year came from Columbia.

Platinum Production of California, by Years.

The annual production and values since 1887, have been as follows:

Year	Ounces	Value	Year	Ounces	Value
1887	100	$400	1909	416	$10,400
1888	500	2,000	1910	337	8,386
1889	500	2,000	1911	511	14,873
1890	600	2,500	1912	603	19,731
1891	100	500	1913	368	17,738
1892	80	440	1914	463	14,816
1893	75	517	1915	667	21,149
1894	100	600	1916	886	42,642
1895	150	900	1917	610	43,719
1896	162	944	1918	571	42,788
1897	150	900	1919	*418	60 611
1898	300	1,800	1920	477	68,977
1899	300	1,800	1921	613	58,754
1900	400	2,500	1922	795	90,288
1901	250	3,200	1923	602	78,546
1902	39	468	1924	273	36,452
1903	70	1,052	1925	292	39,937
1904	123	1,849	1926	322	32,005
1905	200	3,320	1927	139	10,749
1906	91	1,647	1928	312	27,902
1907	300	6,255			
1908	706	13,414	Totals	14,965	$789,469

* Fine ounces, beginning with 1919.

QUICKSILVER

Bibliography: State Mineralogist Reports IV, V, XII-XV, XVII-XXII (inc.). Bulletins 27, 78, 91. U. S. Geol. Surv., Monograph XIII. U. S. Bur. of Mines, Tech. Papers 96, 227; Bulletin 222.

The production of quicksilver for 1928 in California was 7107 flasks (of 76 pounds avoirdupois) valued at $844,649. This was an increase both in quantity and value over the 1927 production, which was 6488 flasks (75 pounds) and $714,418. This production came from Fresno,

[1] Engineering and Mining Journal, Vol. 125 and 126, 1928.

Lake, Napa, Orange, San Benito, San Luis Obispo, Santa Clara and Sonoma counties.

During 1928 the average monthly quotations were over $120 with the highest in September with an average of $128 for a 76-pound flask. In June, 1927, the price quotations changed from a 75-pound flask to a 76-pound flask. The highest average annual price per flask received by the miners was received during the year and was $118.84. This exceeds the 1918 price per flask of $114.03.

The average price for quicksilver in 1928 was $125 for 76-pound flask at San Francisco compared with $117.25 (76-pound flask) in 1927 and $87.64 (75-pound flask) in 1926.

Distribution of the 1928 output of quicksilver by counties was as follows:

County	*Flasks*	*Value*
Lake	1,206	$145,718
Napa	718	85,477
San Benito	3,800	452,345
San Luis Obispo	435	48,254
Fresno, Orange, Santa Clara and Sonoma *	948	112,855
Totals	7,107	$844,649

* Combined to conceal the output of a single operator.

The United States Bureau of Mines reported the total production of the United States for 1928 at 16,838 flasks (75 pounds) valued at $2,052,215 (using $116.60 as the average of New York quotations). Outside of California, the principal yield came from Nevada, Oregon, Texas, Washington and Arizona. Californian production was approximately 43% of the total.

The imported quicksilver[1] in 1928 amounted to 15,583 flasks. Of this, 6189 flasks came from Spain, 5718 flasks from Italy, and 1816 flasks from Mexico with the remaining 1860 flasks coming from Belgium, Germany and United Kingdom. The rise in price in the last quarter of 1926 and during 1927 and 1928 was due to an increased demand in the United States, as shown by the increased production and imports coupled with the continued demand of continental Europe.

Uses.

The most important uses of quicksilver are the recovery of gold and silver by amalgamation, and in the manufacture of fulminate for explosive caps, of drugs, of electric appliances, of scientific apparatus, pigments and cosmetics. By far the greatest consumption is in the manufacture of fulminate and drugs. Radio tubes, Neon and mercury lights and electrical appliances are taking increasing amounts.

Total Quicksilver Production of California.

Total amount and value of the quicksilver production of California, as given in available records, are shown in the preceding tabulation. Though the New Almaden Mine in Santa Clara County was first worked in 1824, and has been in practically continuous operation since 1846 (the yield being small the first two years), there are no available data on the output earlier than 1850. Previous to June, 1904, a 'flask' of quicksilver contained 76½ pounds; then 75 pounds up to and including 1927; beginning with 1928, of 76 pounds. In compiling this table the

[1] U. S. Dept. of Comm. Press Bull. May 29, 1929.

following sources of information were used: for 1850–1883, table by J. B. Randol, in Report of State Mineralogist, IV, p. 336; 1883–1893, U. S. Geological Survey reports; 1894 to date, statistical bulletins of the State Mining Bureau; also State Mining Bureau, Bulletin 27, "Quicksilver Resources of California," 1908, p. 10.

Year	Flasks	Value	Average price per flask	Year	Flasks	Value	Average price per flask
1850	7,723	$768,052	$99 45	1890	22,926	$1,203,615	$52 50
1851	27,779	1,859,248	66 93	1891	22,904	1,036,406	45 25
1852	20,000	1,166,600	58 33	1892	27,993	1,139,595	40 71
1853	22,284	1,235,648	55 45	1893	30,164	1,108,527	36 75
1854	30,004	1,663,722	55 45	1894	30,416	934,000	30 70
1855	33,000	1,767,150	53 55	1895	36,104	1,337,131	37 04
1856	30,000	1,549,500	51 65	1896	30,765	1,075,449	34 96
1857	28,204	1,374,381	48 73	1897	26,691	993,445	37 28
1858	31,000	1,482,730	47 83	1898	31,092	1,188,626	38 23
1859	13,000	820,690	63 13	1899	29,454	1,405,045	47 70
1860	10,000	535,500	53 55	1900	26,317	1,182,786	44 94
1861	35,000	1,471,750	42 05	1901	26,720	1,285,014	48 46
1862	42,000	1,526,700	36 35	1902	29,552	1,276,524	43 20
1863	40,531	1,705,544	42 08	1903	32,094	1,335,954	42 25
1864	47,489	2,179,745	45 90	1904	*28,876	1,086,323	37 62
1865	53,000	2,432,700	45 90	1905	24,655	886,081	35 94
1866	46,550	2,473,202	53 13	1906	19,516	712,334	36 50
1867	47,000	2,157,300	45 90	1907	17,379	663,178	38 16
1868	47,728	2,190,715	45 90	1908	18,039	763,520	42 33
1869	33,811	1,551,925	45 90	1909	16,217	773,788	47 71
1870	30,077	1,725,818	57 38	1910	17,665	799,002	45 23
1871	31,686	1,999,387	63 10	1911	19,109	879,205	46 01
1872	31,621	2,084,773	65 93	1912	20,600	866,024	42 04
1873	27,642	2,220,482	80 33	1913	15,661	630,042	40 23
1874	27,756	2,919,376	105 18	1914	11,373	557,846	49 05
1875	50,250	4,228,538	84 15	1915	14,199	1,157,449	81 52
1876	75,074	3,303,256	44 00	1916	21,427	2,003,425	93 50
1877	79,396	2,961,471	37 30	1917	24,382	2,396,466	98 29
1878	63,880	2,101,652	32 90	1918	22,621	2,579,472	114 03
1879	73,684	2,194,674	29 85	1919	15,200	1,353,381	89 04
1880	59,926	1,857,706	31 00	1920	10,278	775,527	75 45
1881	60,851	1,815,185	29 83	1921	3,157	140,666	44 56
1882	52,732	1,488,624	28 23	1922	3,466	191,851	55 35
1883	46,725	1,343,344	28 75	1923	5,458	332,851	60 98
1884	31,913	973,347	30 50	1924	7,948	543,080	68 33
1885	32,073	986,245	30 75	1925	7,683	621,831	80 81
1886	29,981	1,064,326	35 50	1926	5,892	516,382	87 64
1887	33,760	1,430,749	42 38	1927	6,488	714,418	111 67
1888	33,250	1,413,125	42 50	1928	[1]7,107	844,649	118 84
1889	26,464	1,190,880	45 00				
				Totals	2,233,026	$110,606,568	

* Flasks of 75 lbs. since June, 1904; of 76½ lbs. previously.
[1] Flask of 76 pounds.

SILVER

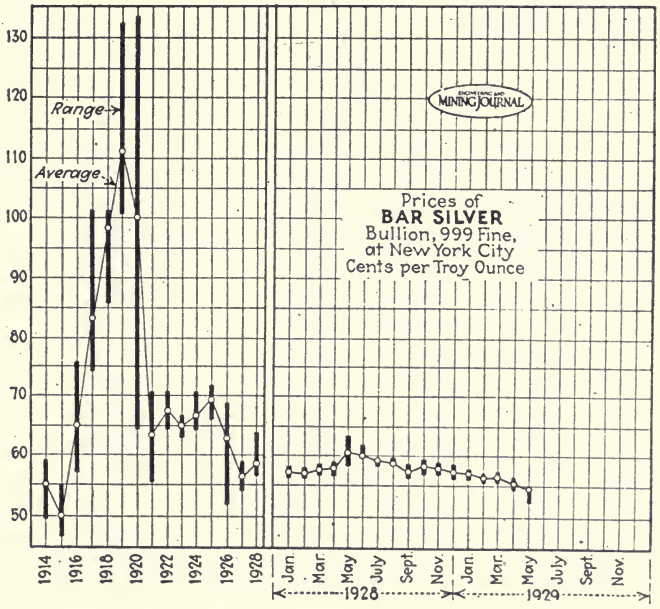
Bibliography: State Mineralogist Reports IV, VIII, XII-XXIII inc.). Bulletins 67, 91. Min. & Sci. Press, March 1, 1919.

Except in the early-day production from the silver mines of the Calico district and the more recent production from those of the Randsburg area, both of which are in San Bernardino County, the recovery of silver in California has been largely as a by-product from its association with copper, lead, and gold ores.

The 1928 silver production of California totals 1,478,771 fine ounces valued at $865,081 compared with the 1927 production which was 1,620,242 fine ounces valued at $918,677. Of the 1928 yield 17,211 fine ounces valued at $10,068 came from placers. The average price of domestic silver during 1928 was 58.5 cents per fine ounce in New York compared with 1927 at 56.7 cents and 1926 at 62.4 cents.

Distribution of the 1928 silver production by counties was as follows:

County	*Fine ounces*	*Value*
Alpine	621	$363
Amador	24,473	14,317
Butte	1,246	729
Calaveras	2,511	1,469
Del Norte	2	1
El Dorado	1,191	697
Fresno	128	75
Humboldt	12	7
Imperial	2	1
Inyo	40,937	23,948
Kern	8,966	5,245
Lassen	14	8
Los Angeles	34	20
Madera	246	144
Mariposa	3,759	2,199
Merced	3	2
Mono	301,052	176,115
Nevada	35,552	20,798
Placer	578	338
Plumas	326,725	191,134
Riverside	2,672	1,563
Sacramento	3,041	1,779
San Bernardino	620,070	362,741
San Diego	22	13
San Luis Obispo	2	1
Shasta	67,403	39,431
Sierra	6,176	3,613
Siskiyou	719	421
Stanislaus	950	556
Trinity	20,954	12,258
Tuolumne	316	185
Yuba	8,394	4,910
Totals	1,478,771	$865,081



From Engineering and Mining Journal, June 15, 1929.

The following paragraphs are quoted from the United States Bureau of Mines, Department of Commerce, Advanced Chapter on Gold and Silver for 1928 by courtesy of Mr. V. C. Heikes, statistician in charge of the San Francisco Branch office:

"The mine production of silver in California in 1928 was 1,478,771 ounces, valued at $865,081, a decrease of 141,471 ounces in quantity and of $53,596 in value as compared with 1927. Named in order of output the silver-producing counties in 1928 were San Bernardino, Plumas and Mono, with Shasta dropping to fourth place with an output of 67,403 ounces of silver compared with 123,917 ounces in 1927.

"The yield of silver from placer operations in 1928 was 17,211 ounces, a decrease of 3692 ounces compared with 1927. Of the 1,461,560 ounces of silver produced from lode mines in the state in 1928, dry silver ore yielded 63 per cent, copper ore and tailings 28 per cent, dry gold ore and tailings 6 per cent, and lead ore nearly 3 per cent, with lead-copper ore yielding a small quantity.

"Thirty-seven companies in California produced 1,421,682 ounces of silver in 1928, with no company in the 1,000,000-ounce class and only one with an output over 500,000 ounces. Three companies produced between 100,000 and 500,000 ounces of silver, 5 between 10,000 and 50,000 ounces, 6 between 5000 and 10,000 ounces, and 22 between 1000 and 5000 ounces. The 10 largest silver-producing companies, named in order of output, were the California Rand Silver (Inc.), Mono Mining Co. of Nevada, Walker Mining Co., Engels Copper Mining Co., Mountain Copper Co. (Ltd.), North Star Mines Co., Island Copper Co., Montana-Tonopah Co., Empire Mines and Investment Co., and the Yuba Consolidated Gold Fields."

Silver Production of California, by Years.

The amount and value of the silver production of California, and the average price, annually, since 1880 are given in the table following. In the table shown in the statistical bulletins previous to Bulletin 97 (for 1925), the value shown for 1880-1904 (inc.) were taken from the reports of the Director of the Mint, of which the figures for 1880-1896 (inc.) were based on 'coinage value' ($1.2929 per fine ounce). We have recalculated these to commercial value, using the price table of the U. S. Geological Survey (McCaskey, H. D., Gold and Silver, 1913: Mineral Resources of the U. S., Part I, p. 847). From 1905 to date, the figures are those of the U. S. Geological Survey and its successor, the U. S. Bureau of Mines:

Year	Fine oz.	Value	Average price per oz.	Year	Fine oz.	Value	Average price per oz.
1880	882,169	$1,014,494	$1 15	1905	1,076,174	$650,009	$0 61
1881	580,091	655,503	1 13	1906	1,220,641	817,830	68
1882	653,569	745,069	1 14	1907	1,138,856	751,646	66
1883	1,129,244	1,253,461	1 11	1908	1,647,278	873,057	53
1884	3,236,987	3,593,056	1 11	1909	2,098,253	1,091,092	52
1885	1,986,260	2,125,298	1 07	1910	1,840,085	993,646	54
1886	1,245,747	1,233,290	0 99	1911	1,270,445	673,336	53
1887	1,262,282	1,237,036	0 98	1912	1,300,136	799,584	615
1888	1,314,874	1,235,982	0 94	1913	1,378,399	832,553	604
1889	823,947	774,510	0 94	1914	1,471,859	813,938	553
1890	820,336	861,353	1 05	1915	1,678,756	851,129	507
1891	737,224	729,852	0 99	1916	2,564,354	1,687,345	658
1892	358,575	311,960	87	1917	1,775,431	1,462,955	824
1893	415,468	324,065	78	1918	1,427,711	1,427,711	1 00
1894	229,896	144,834	63	1919	1,107,189	1,240,051	1 12
1895	463,911	301,542	65	1920	1,706,327	1,859,896	1 09
1896	326,757	222,195	68	1921	3,629,223	3,629,223	1 00
1897	754,648	452,789	60	1922	3,100,065	3,100,065	1 00
1898	701,788	414,055	59	1923	3,559,443	2,918,743	82
1899	855,869	513,521	60	1924	3,555,133	2,381,952	67
1900	1,168,157	724,257	62	1925	3,054,416	2,119,765	694
1901	950,831	570,499	60	1926	2,022,460	1,262,015	624
1902	1,163,041	616,412	53	1927	1,620,242	918,677	567
1903	958,230	517,444	54	1928	1,478,771	865,081	585
1904	1,441,259	835,929	58	Totals	71,182,807	$55,429,705	

TIN

Bibliography: Reports XV, XVII, XVIII. Bulletins 67, 91.

In 1928 there was a small amount of tin produced from Californian ore as well as considerable development work which was done at the Temescal mine in Riverside County near Corona.

There was an output from the district during 1891–1892 as tabulated below. Small quantities of stream tin have been found in some of the placer workings in northern California, but never in paying amounts.

Two occurrences have also been noted, in northern San Diego County. Crystals of cassiterite were found there, associated with blue tourmaline crystals, amblygonite and beryl. No commercial quantity has been developed, only small pockets have been taken out.

On March 12, 1929, the new tin plating plant of the Columbia Steel Corporation at Pittsburg, Contra Costa County, California, started operation. This is the first tin plate mill west of St. Louis. This mill will have an annual capacity of 38,000 tons of tin plate per year and will give the Pacific Coast a local source for their tin plate.

The principal sources of the world's supply of tin are the islands of Banka, Billiton and Singkep, Netherlands India (Dutch East Indies), followed by the Federated Malay States (Perak, Pahang, Negri Sembilan and Selangor). Bolivia, Siam, Cornwall, Transvaal, New South Walls, Queensland and Tasmania are also important sources. A measurable amount of the metal is also recovered by detining scrap and old cans.

Total Output of Tin in California

Year	*Pounds*	*Value*
1891	125,289	$27,564
1892	126,000	32,400
1928	*	*
Totals	251,289	$59,964

* Annual details concealed under "Unapportioned."

TITANIUM

Bibliography: State Mineralogist's Report XXIII.

In 1928 there was only a small shipment of titanium ore in California. This was used for testing purposes. In 1927 the first recorded shipments of titanium minerals were made in California. The total of the 1927 and 1928 production was 10,013 tons valued at $150,195. All of this came from Los Angeles County and was produced from either the black beach sands, which probably contained approximately 20% titaniferous iron and magnetite, the gangue being silica and several silicates, or from a lode deposit in the San Gabriel Mountains.

Titanium is widely distributed in a variety of minerals, but its commercial sources are limited to three forms, rutile (oxide), ilmenite (titanite), and titaniferous magnetite (iron ore rich in titanium). There are several known areas where large deposits of these minerals are found in America, mostly titaniferous iron. Of the titaniferous iron deposits only a portion of the Adirondack deposit, some small deposits in North and South Carolina, and those in Los Angeles County are capable of being separated into a high-grade ilmenite and a low titanium magnetite.

The metal is used in several different alloys with iron, copper and aluminum and for green and white paint pigments, the only colors of titanium pigments now in common use. It is also used in dyes, rubber, as a porcelain glaze, in glass, and cement made from high-titanium iron slags. This cement is resistant to the action of acids.

The market price of titanium minerals varies as to the titanium oxide it contains. Rutile 94% TiO @ 10¢ a pound, ilmenite 50 to 60% TiO @ $9.50 to $11 a ton, and ilmenite 32 to 35% TiO @ $7 to $8 a ton, all prices Atlantic seaboard.

TUNGSTEN

Bibliography: Reports XV, XVII, XVIII, XXII. Bulletins 38, 67, 91, 95. U. S. G. S. Bull. 652. Proc. Colo. Sci. Soc. Vol. XI. South Dakota School of Mines, Bulletin No. 12. Eng. and Min. Jour.-Press, Vol. 113, pp. 666–669, Apr. 22, 1922.

The commercial production of tungsten ores and concentrates in California began in 1905; and has been continuous since, with the exception of 1920–1922 (inclusive), when the mines were shut down owing to low prices due to excess stocks following the war and to lack of tariff protection against foreign importations. Production was resumed on a small scale late in 1923, and is now at practically its pre-war average annual tonnage, though the 1928 figures are more than those for 1927.

The material shipped in 1928 included both high-grade sorted ore and concentrates, coming from Inyo and San Bernardino counties. Prices during 1928 ranged from $10 to $11.25 per unit, duty paid, for Chinese wolframite, with domestic scheelite $10 to $11. Present prices on Chinese wolframite duty paid are $15.75 to $16 and domestic scheelite $16.50 to $17.

Tungsten ore has been produced in California principally in the Atolia-Randsburg district in San Bernardino and Kern counties, followed by the Bishop district in Inyo County, with small amounts coming from Nevada County and from the district near Goffs, in eastern San Bernardino. Most of the California tungsten ore is scheelite (calcium tungstate), though wolframite (iron-manganese tungstate) and hübernite (manganese tungstate) also occur. The deposits at Atolia are the largest and most productive scheelite deposits known,[1] and the output has in some years equaled or exceeded that of ferberite (iron tungstate) from Boulder County, Colorado. It is interesting in this connection to note that, in practically all other tungsten producing districts of the world, wolframite is the important constituent.

Imports of foreign tungsten ore and alloys into the United States during 1928 amounted to 2,729,148 pounds valued at $573,307, compared with 1,613,616 pounds valued at $308,106 in 1927, and 10,362 long tons of ore valued at $11,409,237 in 1918, which ores were duty free up to September 22, 1922. Owing to lack of protection against the cheap coolie labor of Asiatic tungsten mines, and low market prices, practically all of the tungsten mines in the United States were closed down from the middle of 1919 to the latter part of 1923. Quotations during 1922 ranged around $2.50 per unit, up to September. The Tariff Act of 1922 placed a duty on tungsten ore or concentrates of 45¢ per pound on the metallic tungsten contained therein. Duties are also provided for imported tungsten-bearing alloys. Most of the imported ore is coming from China, with smaller amounts from Malaya and Bolivia.

[1] U. S. G. S. Bull. 652, p. 32.

Uses.

The metal, tungsten, is used mainly in the steel industry and in the manufacture of electrical appliances, including the well-known tungsten filament lamps. Because of its resistance to corrosion by acids, it is valuable in making certain forms of chemical apparatus. Its employment in tool-steel alloys permits the operation of cutting tools, such as in lathe work, at a speed and temperature at which carbon steel would lose its temper—hence the name 'high speed' steels for these tungsten alloys. As made in the United States, tungsten forms 13% to 20% of such steels. Some chromium, nickel, cobalt, or vanadium are sometimes also included. Tungsten compounds are used in the manufacture of colors. The indicated consumption is approximately 5000 tons of 60% concentrates per year, in the United States.

Tungsten is introduced into the molten steel charge, either as the powdered metal or as ferro-tungsten (containing 50%–85% tungsten). The specific gravity of the pure metal, 19.3–21.4, is exceeded only by platinum, 21.5; iridium, 22.4; and osmium, 22.5. Its melting point is 3267° C. (5913° F.), being higher than any other known metal. Though millons of tungsten filament lamps are now made, the wires are so fine that the metal they contain represents but a few tons of tungsten concentrates annually.

Total Tungsten Ore Production of California.

The annual amount and value of tungsten ores and concentrates produced in California since the inception of the industry is given herewith, with tonnages recalculated to 60% WO_3:

Year	Tons at 60% WO_3	Value	Year	Tons at 60% WO_3	Value
1905	57	$18,800	1917	2,466	$3,079,013
1906	485	189,100	1918	1,982	2,832,222
1907	287	120,587	1919	214	219,316
1908	105	37,750	1920		
1909	577	190,500	1923	34	19,126
1910	457	208,245	1924	781	446,009
1911	387	127,706	1925	573	348,475
1912	572	206,000	1926	441	316,560
1913	559	234,673	1927		
1914	420	180,575	1928 *	398	429,237
1915	962	1,005,467			
1916	2,270	4,571,521	Totals	14,027	$14,780,878

* Annual details concealed under 'Unapportioned.'

VANADIUM

Bibliography: Report XV. Bulletins 67, 91. Proc. Colo. Sci. Soc., Vol. XI. U. S. Bur. of Mines, Bulletin 104.

No commercial production of vanadium has yet been made in California. Occurrences of this metal have been found at Camp Signal, near Goffs, in San Bernardino County, and two companies at one time did considerable development work in the endeavor to open up paying quantities. Each had a mill under construction in 1916, but apparently no commercial output was made. Ore carrying the mineral cuprodescloizite and reported as assaying 4% V_2O_5 was opened up. Some ore carrying lead vanadate has been developed in the 29 Palms, or Wash-

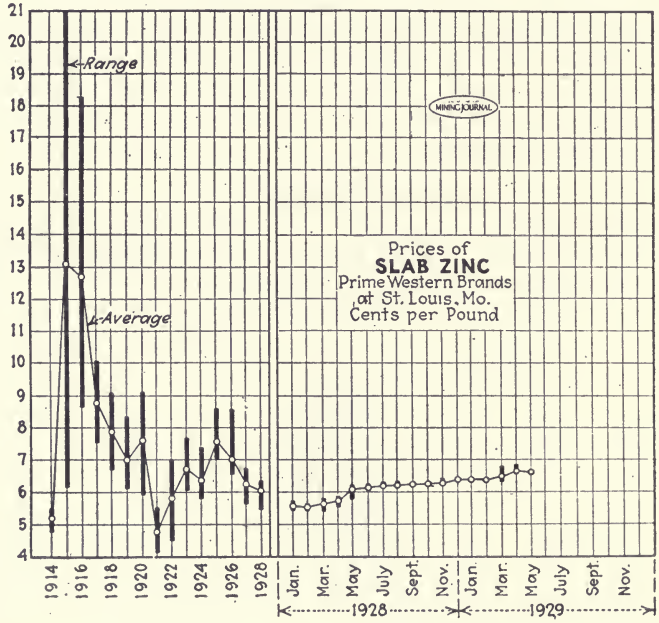
ington district, on the line between Riverside and San Bernardino counties, but no shipments reported.

The principal use of vanadium is as an alloy in steels, especially in tool steel, and in those varieties where resistance to repeated strains is required. Present Now York quotations for ferrovanadium are \$3.15–\$3.50 per pound of vanadium f. o. b. works, and vanadium ore 28¢ per pound V_2O_5 contained.

ZINC

Bibliography: State Mineralogist Reports XIV, XV, XVII, XVIII, XX, XXII, XXIII. Bulletins 38, 67, 91.

There was no recorded production of zinc ores in California during 1928. Owing to the low price of zinc and the distance required to ship the concentrates to smelter, it was impossible to smelt the ore at a profit.



From Engineering and Mining Journal, June 15, 1929.

During the past few years most of California's zinc concentrates have been shipped to Belgium for smelting, although a small amount has been made into zinc oxide here in the state. The American zinc smelters are located along the Mississippi River or on eastern seaboard, with an electrolytic zinc plant in both Idaho and Montana.

The zinc ores of Shasta and Calaveras counties are associated with copper, while those of Inyo, Los Angeles and San Bernardino are associated principally with lead-silver and zinc-silver ores.

The principal uses of zinc are for 'galvanizing' (plating on iron to prevent rust), for zinc oxide (used in rubber goods and paint), and for brass (an alloy of copper and zinc). These outlets for the metal take approximately 80% of the quantity produced. Of the remaining 20%

a large portion is rolled into plates and sheets and utilized in the building industry for sheathing, roofing, leaders, and eaves-troughs. Zinc is particularly desirable and efficient for roofing and siding where corrosive gases are present, as at smelters, refineries and chemical plants.

Zinc Production of the United States.

The production of slab zinc[1] at reduction plants in the United States in 1928 amounted to 582,100 short tons valued at $73,344,600, not including 12,400 tons of primary metal made from foreign ores, mostly from Mexico, and reduced in refineries in this country. The 1928 production was an increase from that of 1927 of 5,140 tons.

The average price per pound quoted for the metal in 1928 was 6.03¢ as against 6.4¢ in 1927.

Total Zinc Production of California.

Total figures for zinc output of the state are as follows, commercial production dating back only to 1906:

Year	Pounds	Value	Year	Pounds	Value
1906	206,000	$12,566	1918	5,565,561	$506,466
1907	177,759	10,598	1919	1,384,192	101,046
1908	54,000	3,544	1920	1,188,009	96,229
1909			1921	846,184	42,309
1910			1922	3,034,430	172,963
1911	2,679,842	152,751	1923		
1912	4,331,391	298,866	1924	3,060,000	198,900
1913	1,157,947	64,845	1925	11,546,602	877,542
1914	399,641	20,381	1926	20,447,559	1,533,568
1915	13,043,411	1,617,383	1927	8,625,004	552,000
1916	15,950,565	2,137,375	1928		
1917	11,854,804	1,209,190	Totals	105,552,901	$9,608,522

[1] U. S. Bureau of Mines, Department of Commerce. Press Bulletin Jan. 7, 1929.

CHAPTER FOUR

STRUCTURAL MATERIALS

Bibliography: State Mineralogist Reports XII–XXIII (inc.). Bulletin 38. Spurr and Wormser, "Marketing of Metals and Minerals." "Non-Metallic Minerals," by R. B. Ladoo. See also under each substance.

As indicated by this subdivision heading, the mineral substances herein considered are those more or less directly used in building and structural work. California is independent, so far as these are concerned, and almost any reasonable construction can be made with materials produced in the state. This branch of the mineral industry for 1928 was valued at $49,509,386 as compared with a total value of $54,861,649 for the year 1927. All minerals in this group showed a decrease in value with the exception of bituminous rock, chromite and slate, owing to the decline in building during the year.

The 1927 output established a new record both in quantity and total value, exceeding the previous total value record made in 1923 by over a million dollars.

Crushed rock production is yearly becoming more worthy of consideration, due to the strides taken in the use of concrete, as well as to activity in the building of good roads. Brick, with an average annual output for a number of years worth approximately $2,000,000, had difficulty in holding its own, due to the popularity of cement and concrete. In 1920, however, the sales increased to nearly double the previous record figure of the year 1907, and in 1923 showed advances to new figures, with a slight recession in 1924–1928. This item will, no doubt, continue to be an important one, and a market for fire and fancy brick of all kinds will unquestionably never be lacking.

All fifty-eight counties contributed to this structural total for 1926. There is not a county in the state which is not capable of some output of at least one of the materials under this classification.

During 1928 building construction on the Pacific Coast has declined in the large cities and increased in the smaller towns. The principal cities show a falling off of approximately 20 per cent in the total of building permits during the year.

The following summary shows the value of the structural materials produced in California during the years 1927–1928, with increases or decreases in each instance.

Substance	1927		1928		Increase+ Decrease— Value
	Amount	Value	Amount	Value	
Bituminous rock	3,515 tons	$17,704	4,966 tons	$33,832	$16,128+
Brick and hollow tile		6,516,077		5,694,770	821,307—
Cement	14,661,783 bbls.	26,474,935	13,625,231 bbls.	24,463,287	2,011,648—
Chromite	225 tons	5,063	729 tons	15,179	10,116+
Granite		1,398,443		763,996	634,447—
Lime	60,498 tons	631,497	56,616 tons	547,919	83,578—
Magnesite	46,093 tons	577,887	45,645 tons	501,590	76,297—
Marble [1]	42,308 cu. ft.	103,689	34,324 cu. ft.	82,190	21,499—
Sandstone	22,900 cu. ft.	205,400	134,100 cu. ft.	43,250	162,150—
Slate		17,960		31,263	13,303+
Stone, Miscellaneous		18,912,994		17,332,110	1,580,884—
Total value		$54,861,649		$49,509,386	
Net decrease					$5,352,263

[1] Includes onyx and travertine.

ASPHALT

Bibliogrpahy: State Mineralologist Reports VII, X, XII–XV (inc.), XVII, XVIII. Bulletins 16, 32, 63, 67, 69, 91.

Asphalt was for a number of years accounted for in the statistical reports by the State Mining Bureau, because in the early days of the oil industry, considerable asphalt was produced from outcroppings of oil sand, and was a separate industry from the production of oil itself. However, at the present time most of the asphalt comes from the oil refineries, which produce a better and more uniform grade; hence, its value is not now included in the mineral total, as to do so would be in part a duplication of the crude petroleum figures. Such natural asphalt as is at present mined is in the form of bituminous sandstones, and is recorded under that designation.

BITUMINOUS ROCK

Bibliography: State Mineralogist Reports XII, XIII, XV, XVII, XVIII, XXI, XXII.

This material is essentially an uncemented sandstone which is saturated with and held together by a natural asphaltic constituent, probably the residue from the evaporation of a crude petroleum deposit. Bituminous rock is still used to a limited extent for road dressing in those districts adjacent to available deposits, though the manufacture of asphalt at the oil refineries has almost entirely superseded the direct use of the native material. Some of the Santa Cruz County production is put on the market as a material which can be laid cold. This material is especially applicable and valuable for patch jobs.

Shipments from quarries in Santa Barbara and Santa Cruz counties in 1928 totaled 4966 tons of bituminous rock valued at $33,832 rail shipment. This was an increase both in quantity and value over the 1927 production, which was 3515 tons and $17,704.

Bituminous Rock Production of California, by Years.

The following tabulation shows the total amount and value of bituminous rock quarried and sold in California, from the records compiled by the State Mining Bureau, annually since 1887:

Year	Tons	Value	Year	Tons	Value
1887	36,000	$160,000	1909	34,123	$116,436
1888	50,000	257,000	1910	87,547	165,711
1889	40,000	170,000	1911	75,125	117,279
1890	40,000	170,000	1912	44,073	87,467
1891	39,962	154,164	1913	37,541	78,479
1892	24,000	72,000	1914	66,119	166,618
1893	32,000	192,036	1915	17,789	61,468
1894	31,214	115,193	1916	19,449	66,561
1895	38,921	121,586	1917	5,590	18,580
1896	49,456	122,500	1918	2,561	9,067
1897	45,470	128,173	1919	4,614	18,537
1898	46,836	137,575	1920	5,450	27,825
1899	40,321	116,097	1921	8,298	43,192
1900	25,306	71,495	1922	4,624	13,570
1901	24,052	66,354	1923	2,945	11,780
1902	33,490	43,411	1924	6,040	14,922
1903	21,944	53,106	1925	2,681	10,724
1904	45,280	175,680	1926	3,863	21,577
1905	24,753	60,436	1927	3,515	17,704
1906	16,077	45,204	1928	4,966	33,832
1907	24,122	72,835			
1908	30,718	109,818	Totals	1,196,835	$3,715,992

BRICK AND HOLLOW TILE

Bibliography: State Mineralogist Reports VIII, X, XII–XV (inc.), XVII–XXIII (inc.). Bulletins 38, 99. Preliminary Report, No. 7. Cal. Jour. of Development, June, 1925, pp. 5–6.

Bricks of many varieties and in important quantities are annually produced in California, as might be expected in a state with such diversified and widespread mineral resources. The varieties include common, fire, pressed, glazed, enamel, fancy, vitrified, sand-lime, and others. Not only do the plants here supply practically all of our own requirements in these products, but considerable quantities are shipped to contiguous territory and certain products are shipped over a much wider radius. So far as possible, the different kinds have been segregated in the tabulation herewith accompanying.

We also include under this heading the various forms of hollow building 'tile' or blocks. The application of these tile to residence construction as well as to other structures is growing; though their total for 1928 shows an increase from the figures of 1927.

The aggregate value of all kinds of brick in 1928 shows a decrease of approximately 16 per cent from that of 1927, to which each of the groups contributed.

Bulletin No. 99, "The Clay Resources and the Ceramic Industry of California," published last year (1928) covers all the brick plants throughout the state, giving a detailed description of each.

The detailed figures of brick and hollow building tile for 1928 by counties are shown in the following tabulation:

Brick and Hollow Building Tile for 1928, by Counties

County	Common		Fire		Glazed, pressed, fancy, vitrified, paving		Hollow building tile or blocks		Total value
	Amount M	Value	Amount M	Value	Amount M	Value	Tons	Value	
Butte	960	$16,320							$16,320
Kern	2,126	30,791							30,791
Los Angeles	136,206	1,566,913	6,987	$383,640	5,199	$241,390	29,302	$577,397	2,769,340
Riverside	*		7,301	302,903	7,691	115,938	2,250	20,637	439,478
Sacramento	12,040	203,235	*		*		*		203,235
San Diego	6,871	71,835	*		*		*		71,835
San Joaquin	7,384	85,588	*				*		85,588
Santa Clara	14,622	157,732							157,732
Alameda, Contra Costa, Fresno, Humboldt, Imperial, Marin, Orange, Riverside, San Luis Obispo, Santa Barbara, Tehama, Tulare, Ventura*	44,705	617,736							617,736
Alameda, Amador, Contra Costa, Fresno, Merced, Placer, Sacramento, San Diego, San Joaquin*			13,936	629,866					629,866
Alameda, Contra Costa, Fresno, Merced, Placer, Sacramento, San Diego, Ventura*					15,418	300,747			300,747
Alameda, Contra Costa, Fresno, Merced, Placer, Sacramento, San Diego, San Joaquin, San Luis Obispo, Santa Barbara, Santa Clara, Ventura*							34,725	372,102	372,102
Totals	215,914	$2,750,150	28,224	$1,316,409	28,308	$658,075	66,277	970,136	$5,694,770

* Combined to conceal output of a single operator in each.

Brick and Hollow Tile Production of California, by Years.

Record of brick production in the state has been kept since 1893 by this Bureau, the figures for hollow building 'tile' or blocks being also included since 1914. The annual and total figures, for amount and value, are given in the following table:

Year	*Brick, M*	*Hollow building blocks, tons*	*Value*
1893	103,900	------	$801,750
1894	81,675	------	457,125
1895	131,772	------	672,360
1896	24,000	------	524,740
1897	97,468	------	563,240
1898	100,102	------	571,362
1899	125,950	------	754,730
1900	137,191	------	905,210
1901	130,766	------	860,488
1902	169,851	------	1,306,215
1903	214,403	------	1,999,546
1904	281,750	------	1,994,740
1905	286,618	------	2,273,786
1906	277,762	------	2,538,848
1907	362,167	------	3,438,951
1908	332,872	------	2,506,495
1909	333,846	------	3,059,929
1910	340,883	------	2,934,731
1911	327,474	------	2,638,121
1912	337,233	------	2,940,290
1913	358,754	------	2,915,350
1914	270,791	------	2,288,227
1915	180,538	------	1,678,756
1916	206,960	------	2,096,570
1917	192,269	29,348	2,532,721
1918	136,374	34,818	2,363,481
1919	156,328	36,026	3,087,067
1920	245,842	99,208	5,704,393
1921	238,022	67,100	5,570,875
1922	374,853	105,909	7,994,991
1923	397,754	122,534	9,738,082
1924	456,716	114,469	9,137,908
1925	361,094	105,491	7,503,976
1926	388,048	90,332	7,026,124
1927	374,111	75,116	6,516,077
1928	272,443	66,277	5,694,770
Totals	8,808,580	946,628	$115,592,025

CEMENT

Bibliography: State Mineralogist Reports VIII, IX, XII, XIV, XV, XVII, XVIII, XXI–XXIII, Bulletin 38.

Cement is the most important single structural material in the mineral output of California. During 1928 there was a total of 13,625,231 barrels valued at $24,463,287 f.o.b. plant, being a decrease in both quantity and value. The 1927 output was 14,661,783 barrels valued at $26,474,935 or an average of $1.80 per barrel. The 1928 average value was $1.79 per barrel.

The 1928 production came from eleven operating plants in nine counties and employing a total of 2088 men. Three plants in San Bernardino County made a total of 4,383,383 barrels valued at $7,137,606, the balance of the state's production coming from a single plant in each of the following counties: Calaveras, Contra Costa, Kern, Merced, Riverside, San Benito, San Mateo and Santa Cruz.

There has been an interesting parallelism in the growth of the Portland cement and the crushed rock, sand and gravel industries in California. The use of concrete has been a most important development in

structural work during the last 20 or 30 years, and has made possible the building of such great monolithic structures as our irrigation and hydroelectric-power dams, as well as highway pavements and sky-scraper office buildings.

Cement Production of California, by Years.

'Portland' cement was first commercially produced in California in 1891; though in 1860 and for several years following, a natural hydraulic cement from Benicia was utilized in building operations in San Francisco.

[1] "The Benicia Cement Company in 1859–60 was turning out 50 to 100 barrels of cement a day and San Francisco was using about 12,000

Douglas Memorial Bridge over Klamath River, Del Norte County, a reinforced concrete structure. Photo by Walter W. Bradley.

barrels a year. The mill price of the product was then $4 a barrel. By 1865, the San Francisco rate of consumption had increased to 100,000 barrels yearly, brick buildings largely taking the place of frame structures, and the price of cement had fallen to $2.50 a barrel, about the same as it is today."

The growth of the industry became rapid after 1902; since which time cement has continued to be an important factor in the industrial life of the state. Although the total cement figures, to date, are not of the same magnitude as those for gold and petroleum, it is interesting to note that the value of California's cement yield beginning with 1920 has since annually exceeded the value of her gold output.

[1] Monthly Review of Mercantile Trust Co. of Cal., Vol. XIII, No. 3, p. 55, Mar. 1924.

Annual production of cement in California has been as follows:

Year	Barrels	Value	Year	Barrels	Value
1891	5,000	$15,000	1911	6,371,369	$9,085,625
1892	5,000	15,000	1912	6,198,634	6,074,661
1893			1913	6,167,806	7,743,024
1894	8,000	21,600	1914	5,109,218	6,558,148
1895	16,383	32,556	1915	4,918,275	6,044,950
1896	9,500	28,250	1916	5,299,507	6,210,293
1897	18,000	66,000	1917	5,790,734	7,544,282
1898	50,000	150,000	1918	4,772,921	7,969,909
1899	60,000	180,000	1919	4,645,289	8,591,990
1900	52,000	121,000	1920	6,709,160	14,962,945
1901	71,800	159,842	1921	7,404,221	18,072,120
1902	171,000	423,600	1922	8,962,135	16,524,056
1903	640,868	968,727	1923	10,825,405	25,999,203
1904	969,538	1,539,807	1924	11,655,131	23,225,850
1905	1,265,553	1,791,916	1925	13,206,630	25,043,335
1906	1,286,000	1,941,250	1926	13,797,173	25,269,678
1907	1,613,563	2,585,577	1927	14,661,783	26,474,935
1908	1,629,615	2,359,692	1928	13,625,231	24,463,287
1909	3,779,205	4,969,437			
1910	5,453,193	7,485,715	Totals	167,224,840	$290,713,250

CHROMITE

Bibliography: State Mineralogist Reports IV, XII, XIII, XIV, XV, XVII, XVIII, XXI–XXIII. Bulletins 38, 76, 91. Preliminary Report 3. U. S. G. S., Bull. 430. Min. & Sci. Press, Vol. 114, p. 552.

Chrome iron ore or chromite to the amount of 729 short tons recalculated to the basis of 45% Cr_2O_3 valued at $15,179 f.o.b. shipping point was sold in California during 1928. This was an increase over the 1927 production which was 225 tons, valued at $5,063. This material came from San Luis Obispo, Shasta, Sonoma and Trinity counties with a single operator in each. The grade varied from 40 to 53 per cent Cr_2O_3. About half of the above material was mined during the year, the remainder being mined during the World War period but was not sold then.

It is hoped that the development of the steel industry and the resumption of copper smelting on the Pacific Coast may create some demand for California's chromite, but the outlook for the immediate future is not encouraging.

The political and commercial control of chromite now rests largely with England, through the ownership and sales contracts exercised by the Chrome Company (Ltd.), of London. That company controls both the Rhodesian and the New Caledonian output.

Occurrence.

Until 1916, when some shipments were made from Oregon and smaller amounts from Maryland, Wyoming and Washington, practically our only domestic production of chromite for many years came from California. From 1830 to 1870 the deposits in Maryland supplied the world's consumption.

Chromite is widely distributed in California, the principal production, thus far, having come from El Dorado, San Luis Obispo, Del Norte, Shasta, Siskiyou, Placer, Fresno, and Tuolumne counties. In 1918 a total of 29 counties contributed to the state's output. There are two main belts in California yielding this mineral, one along the Coast Ranges from San Luis Obispo County to the Oregon line, including the Klamath Mountains at the north end, and the other in the Sierra Nevada from Tulare County to Plumas County. Chromite occurs as lenses in basic igneous rocks such as peridotite and pyroxenite, and in serpentines which have been derived by alteration of such basic rocks. For the most part, so far as developments have yet shown, the lenses have proved to be small, relatively few of them yielding over 100 tons apiece. A notable exception to this was the deposit on Little Castle Creek, near Dunsmuir, from which upwards of 15,000 tons were shipped before it was exhausted. Deposits worked in Del Norte County during 1918 promise well for a large tonnage. On the whole the orebodies in the northwestern corner of the state appear to average larger in size than the chromite lenses in other parts of California.

Concentration became an accomplished fact in several localities, thus utilizing some of the disseminated and lower-grade orebodies which have been found. In fact, an important part of the 1918–1920 production of California came from that source.

Imports.

Importations of foreign chromite duty free, mainly from Rhodesia, New Caledonia and India, totaled 216,592 long tons in 1928, valued at $1,704,988, compared with 222,360 long tons, worth $1,748,598 in 1927.

Uses.

The major consumption of chromite ore is for use as a refractory lining in smelting furnaces for steel and copper. A smaller portion is used in the preparation of ferrochrome for chrome-steel alloys, and of chromium chemicals, the latest development of which is chrome plating as used in the automobile industry, on ships, and in oil refineries to protect metal surfaces from wear and erosion. It is stated that during the last five years, the sales of chromite brick and chromite cement have increased 500%, because of their replacing magnesite which is more expensive.

Total Chromite Production of California.

Production of chromite in California began, apparently, about 1874, principally in San Luis Obispo County. There was considerable activity from 1880 to 1883, inclusive, and a total of 23,238 long tons (or 26,028 short tons), valued at $329,924 was shipped from that county up to the beginning of 1887. Some ore also was shipped from the Tyson properties in Del Norte County. The tabulation herewith shows the output of chromite in California, annually, including the earliest

figures so far as they are available. The figures from 1887 to date are from the records of the State Mining Bureau:

Year	Tons	Value	Year	Tons	Value
1874–1876 (San Luis Obispo County)	26,028	$329,924	1908	350	$6,195
1887	3,000	40,000	1909	436	5,309
1888	1,500	20,000	1910	749	9,707
1889	2,000	30,000	1911	935	14,197
1890	3,599	53,985	1912	1,270	11,260
1891	1,372	20,580	1913	1,180	12,700
1892	1,500	22,500	1914	1,517	9,434
1893	3,319	49,785	1915	3,725	38,044
1894	3,680	39,980	1916	48,943	717,244
1895	1,740	16,795	1917	52,379	1,130,298
1896	786	7,775	1918	73,955	3,649,497
1897			1919	*4,314	97,164
1898			1920	1,770	43,031
1899			1921	347	6,870
1900	140	1,400	1922	379	6,334
1901	130	1,950	1923	84	1,658
1902	315	4,725	1924	350	6,700
1903	150	2,250	1925	191	3,712
1904	123	1,845	1926	393	7,063
1905	40	600	1927	225	5,063
1906	317	2,859	1928	729	15,179
1907	302	6,040	Totals	244,264	$6,450,202

*Recalculated to 45% Cr_2O_3, beginning with 1919.

GRANITE

Bibliography: State Mineralogist Reports, X, XII–XXI (inc.). Bulletin 38.

The value of the granite output in 1928 was $763,996, a decrease from the 1927 figure of $1,398,443.

We have included under this heading some rhyolite and tuff utilized for dimension building stone, as we have no other dimension-stone grouping for statistical purposes in this report except marble and sandstone.

So far as possible, granite production has been segregated in the table herewith into the various uses to which the product was put. It will be noted, however, that a portion of the output has been entered under the heading 'Unclassified.' This is necessary because of the fact that some of the producers have no way of telling to what specific use their stone was put after they had quarried and sold the same in the rough.

Varieties.

For building purposes, the granites found in California, particularly the varieties from Raymond in Madera County, Rocklin in Placer County, and near Porterville in Tulare County, are unexcelled by any similar stone found elsewhere. The quantities available, notably at Raymond and Porterville, are unlimited. Most of California's 'granite,' particularly that found in the Sierra Nevada Mountains, is technically 'granodiorite' (that is, both plagioclase and orthoclase feldspars are present).

Granites of excellent quality for building and ornamental purposes are also quarried in Riverside and San Diego counties. Near Lakeside, San Diego County, there is a fine-grained, 'silver gray' granite of

uniform texture and color, especially suited for monumental and ornamental work.

The Fresno County stone is a dark, hornblende diorite, locally called 'black granite,' whose color permits of a fine contrast of polished and unpolished surfaces, making it particularly suitable for monumental and decorative purposes. There is also a similar 'black granite' in Tulare County, near Success.

Granite Production by Counties for 1928

County	Building stone		Monumental		Curbing		Unclassified		Total value
	Cubic ft.	Value	Cubic ft.	Value	Linear ft.	Value	Cubic ft.	Value	
Fresno	[b]5,500	$12,750	[b]						$12,750
Lassen			1,050	$1,100	*	*			1,100
Mariposa					1,475	$1,475	25,026	$12,513	13,988
Placer	1,350	5,740	11,020	13,915					19,655
Sacramento	9,181	18,362	648	1,296					19,658
San Diego	800	1,600	11,036	39,899					41,499
Alpine, Inyo[a], Madera, Nevada, Tulare*	45,772	205,780							205,780
Fresno, Madera, Nevada, Plumas, Riverside, Tulare*			149,081	380,001					380,001
Lassen, Madera, Nevada*					2,480	4,215			4,215
Los Angeles, Madera, Ventura*							51,655	65,350	65,350
Totals	62,603	$244,232	172,835	$436,211	3,955	$5,690	76,681	$77,863	$763,996

* Combined to conceal output of a single operator in each.
[a] Tuff used for building stone.
[b] Includes some monumental stone.

Granite Production of California, by Years.

The value of granite produced, annually, since 1887, has been as follows:

Year	Value	Year	Value
1887	$150,000	1909	$376,834
1888	57,000	1910	417,898
1889	1,329,018	1911	355,742
1890	1,200,000	1912	362,975
1891	1,300,000	1913	981,277
1892	1,000,000	1914	628,786
1893	531,322	1915	227,928
1894	228,816	1916	535,339
1895	224,329	1917	221,997
1896	201,004	1918	139,861
1897	188,024	1919	220,743
1898	147,732	1920	495,732
1899	141,070	1921	725,901
1900	295,772	1922	676,643
1901	519,285	1923	760,081
1902	255,239	1924	1,211,046
1903	678,670	1925	1,853,859
1904	467,472	1926	655,332
1905	353,837	1927	1,398,443
1906	344,083	1928	763,996
1907	373,376		
1908	512,923	Totals	$23,509,385

LIME

Bibliography: Reports XIV, XV, XVII, XVIII. Bulletin 38.

Lime to the amount of 56,616 tons valued at $547,919 was produced by seven plants in five counties in California during 1928 as compared with 60,498 tons valued at $631,497 in 1927. There were two plants each in San Bernardino and Santa Cruz counties, and one each in Kern, Tulare and Tuolumne counties.

So far as we have been able to segregate the data, these figures include mainly only such lime as is used in building operations; though they do include a small proportion of calcined lime employed in agriculture and the chemical industries, the figures for which were not separable. A portion is hydrated lime. Limestone utilized in sugar making, for smelter flux, as a fertilizer, and other special industrial uses, are classified under 'Industrial Materials.' That consumed in cement manufacture is included in the value of cement.

Lime Production of California, by Years.

The following tabulation gives the amounts and value of lime produced in California by years since 1894 when compilation of such records was begun by the State Mining Bureau. The figures for quantity have been recalculated from 'barrels' to 'tons' for the years 1894–1922 (inc.):

Year	Tons	Value	Year	Tons	Value
1894	37,350	$318,700	1912	52,212	$464,440
1895	39,776	386,094	1913	61,344	528,547
1896	30,275	261,505	1914	43,996	378,663
1897	28,780	252,900	1915	35,653	286,304
1898	29,786	254,010	1916	49,364	390,475
1899	29,985	314,575	1917	50,073	311,380
1900	31,252	283,699	1918	43,684	461,315
1901	31,738	334,688	1919	42,070	552,043
1902	44,866	369,616	1920	46,314	557,232
1903	49,659	418,280	1921	46,353	610,619
1904	57,945	571,749	1922	57,875	671,747
1905	61,700	555,322	1923	70,894	788,834
1906	68,927	763,060	1924	62,029	703,355
1907	68,422	756,376	1925	61,922	685,528
1908	39,639	379,243	1926	63,568	670,837
1909	52,075	577,824	1927	60,498	631,497
1910	47,951	477,683	1928	56,616	547,919
1911	42,959	390,988	Totals	1,697.550	$16,907,047

MAGNESITE

Bibliography: State Mineralogist Reports XII–XV (inc.), XVII–XXIII. Bulletins 38, 79, 91. U. S. Geol. Surv. Bulletins 355, 540; Min. Res. 1913, Pt. II, pp. 450–453. Min. & Sci. Press, Vol. 114, p. 237. "Magnesite"—Hearings before the Comm. on Ways and Means, House of Repr., on H. R. 5218, June 16, 17, and July 17, 1919. Eng. Soc. W. Penn., Proc. 1913, Vol. 29, pp. 305–388, 418–444. Eng. & Min. Jour.-Press, Vol. 114, July 29, and Dec. 2, 1922. U. S. Tariff Comm., "Crude and Caustic Calcined Magnesite. A Preliminary Statement of Information," May 19, 1926.

The production of magnesite in California during 1928 amounted to a total of 45,645 tons crude ore valued at $501,590. Only a very small part of it was sold "crude," however, as it was practically all shipped in the calcined form. The reports at hand show a total of 18,887 tons shipped calcined; of this about 26 per cent was dead-burned for refractory purposes, the balance going to the plastic trade. This material came from San Benito, Santa Clara, Stanislaus and Tulare counties with a single producer in each. From 2 to 2½ tons of crude material are mined to make one ton of calcined. The 1928 output is a decrease both in quantity and value from the 1927 figure which was 46,093 tons crude valued at $577,887. The average of the values reported for 1928 is $11 per ton compared with $12.50 in 1927.

Occurrence.

Magnesite is a natural carbonate of magnesium, and when pure contains 52.4% CO_2 (carbon dioxide), and 47.6% MgO (magnesia). It has a hardness of 3.5 to 4.5, and specific gravity of 3 to 3.12. It is both harder and heavier than calcite (calcium carbonate), and also contains a higher percentage of CO_2 as calcite has but 44%.

Most of the Californian magnesite is comparatively pure, and is ordinarily a beautiful, white, fine-grained rock with a conchoidal fracture resembling a break in porcelain. The Grecian magnesite is largely of this character; but the Austrian varieties usually contain iron, so that they become brown after calcining. The Washington magnesite resem-

bles dolomite and some crystalline limestones in physical appearance. Its color varies through light to dark gray, and pink.

In California the known deposits are mostly in the metamorphic rocks of the Coast Ranges and the Sierra Nevada, being associated with serpentine areas. The notable exceptions are the sedimentary deposits at Bissell in Kern County and at Afton in San Bernardino County. Several thousand tons have been shipped from the Bissell deposit; and small shipments have been made from the Afton property.

The Washington deposits are associated with extensive strata of dolomite limestone. The magnesite there appears to contain more iron than most of the California mineral, which makes it desirable for the steel operators. However, recent experience has proved that several California localities have sufficient iron in their magnesite to be serviceable in the steel furnaces.

Uses.

The principal uses include: Refractory linings for basic open-hearth steel furnaces, copper reverberatories and converters, bullion and other metallurgical furnaces; in the manufacture of paper from wood pulp; and in structural work, for exterior stucco, for flooring, wainscoting, tiling, sanitary kitchen and hospital finishing, etc. In connection with building work it has proved particularly efficient as a flooring for steel railroad coaches, on account of having greater elasticity and resilience than 'Portland' cement. For refractory purposes the magnesite is 'dead-burned'—*i. e.*, all or practically all of the CO_2 is expelled from it. For cement purposes it is left 'caustic'—*i. e.*, from 2% to 10% of CO_2 is retained. When dry caustic magnesite is mixed with a solution of magnesium chloride ($MgCl_2$) in proper proportions, a very strong cement is produced, known as oxychloride or Sorel cement. It is applied in a plastic form, which sets in a few hours, as a tough, seamless surface. It has also a very strong bonding power, and will hold firmly to wood, metal, or concrete as a base. It may be finished with a very smooth, even surface, which will take a good wax or oil polish. As ordinarily mixed there is added a certain proportion of wood flour, cork, asbestos, or other filler, thereby adding to the elastic properties of the finished product. Its surface is described as 'warm' and 'quiet' as a result of the elastic and nonconducting character of the composite material. The cement is frequently colored by the addition of some mineral pigment to the materials before mixing as cement.

For refractory purposes the calcined magnesite is largely made up into bricks similar to fire-brick for furnace linings. It is also used unconsolidated, as 'grain' magnesite. For such, an iron content is desirable, as it allows a slight sintering in forming the brick. Dead-burned, pure magnesia can not be sintered except at very high temperatures; and it has little or no plasticity, so that it is hard to handle. Its plasticity is said to be improved by using with it some partly calcined or caustic magnesite. Heavy pressure will bind the material sufficiently to allow it to be sintered.

A coating of crushed magnesite is laid on hearths used for heating steel stock for rolling, to prevent the scale formed from attacking the fire-brick of the hearth.

Before the World War, practically all of the domestic output of caustic magnesite was used in the manufacture of pulp and paper. For this purpose calcined dolomite is now used. The use of dolomite instead of magnesite by paper manufacturers began during the war when the price of magnesite was very high. Dolomite was found to be a good substitute for magnesite in the bisulphite process of paper making and so its use has continued.

Imports.

The Tariff act of 1922, which became effective September 22d, of that year, placed the following import duties on magnesite: Crude magnesite 5/16¢ per lb., caustic-calcined magnesite 5/8¢ per lb.; dead-burned and grain magnesite, not suitable for manufacture into oxy-chloride cements, 23/40¢ per lb.; magnesite brick, 3/4¢ per lb. and 10% ad valorem. The figures of imports for 1928, as published by the U. S. Bureau of Foreign and Domestic Commerce, show a total of 63,500 short tons of calcined ore, valued at $974,869, as compared with 60,224 tons and $959,483 in 1927.

Total Magnesite Production of California.

The first commercial production of magnesite in California was made in the latter part of 1886 from the Cedar Mountain district,[1] southeast of Livermore, Alameda County. Shipments amounting to 'several tons' or 'several carloads' were sent by rail to New York; but there is apparently no exact record of the amount for that first year. The statistical records of the State Mining Bureau began with the year 1887, and the table herewith shows the figures for amount and value, annually, from that time. Shipments of magnesite from Napa County began in 1891 from the Snowflake Mine; from the Red Mountain deposits in Santa Clara County, in 1899; and from Tulare County in 1900.

Year	Tons	Value	Year	Tons	Value
1887	600	$9,000	1909	7,942	$62,588
1888	600	9,000	1910	16,570	113,887
1889	600	9,000	1911	8,858	67,430
1890	600	9,000	1912	10,512	105,120
1891	1,500	15,000	1913	9,632	77,056
1892	1,500	15,000	1914	11,438	114,380
1893	1,093	10,930	1915	30,271	283,461
1894	1,440	10,240	1916	154,052	1,311,893
1895	2,200	17,000	1917	209,648	1,976,227
1896	1,500	11,000	1918	83,974	803,492
1897	1,143	13,671	1919	44,696	452,094
1898	1,263	19,075	1920	83,695	1,033,491
1899	1,280	18,480	1921	47,837	511,102
1900	2,252	19,333	1922	55,637	594,665
1901	4,726	43,057	1923	73,963	946,643
1902	2,830	20,655	1924	67,236	900,183
1903	1,361	20,515	1925	64,623	872,944
1904	2,850	9,298	1926	50,915	587,642
1905	3,933	16,221	1927	46,093	577,887
1906	4,032	40,320	1928	45,645	501,590
1907	6,405	57,720			
1908	10,582	80,822	Totals	1,177,977	$12,368,112

[1] See U. S. Geol. Surv.; Mineral Resources of U. S., 1886, pp. 6 and 696.

MARBLE

Bibliography: State Mineralogist Reports XII–XV (inc.), XVII–XXII (inc.). Bulletin 38. U. S. Bur. of Mines, Bull. 106.

Marble is widely distributed in California, and in a considerable variety of colors and grain. The 1928 figures show a slight decline in both quantity and value from those of 1927, and are combined with onyx and travertine to conceal the output of a single operator in both Santa Barbara and Tuolumne counties.

California has many beautiful and serviceable varieties of marble, suitable for almost any conceivable purpose of construction or decoration. In the decorative class are deposits of onxy marble of beautiful coloring and effects. There is also serpentine marble suitable for electrical switchboard use.

Marble Production of California, by Years.

Data on annual production since 1887, as compiled by the State Mining Bureau, follows. Previous to 1894 no records of amounts were preserved.

Year	Cubic feet	Value	Year	Cubic feet	Value
1887		$5,000	1909	79,600	$238,400
1888		5,000	1910	18,960	50,200
1889		87,030	1911	20,201	54,103
1890		80,000	1912	27,820	74,120
1891		100,000	1913	41,654	113,282
1892		115,000	1914	25,436	48,832
1893		40,000	1915	22,186	41,518
1894	38,441	98,326	1916	25,954	50,280
1895	14,864	56,566	1917	24,755	62,950
1896	7,889	32,415	1918	[a]17,428	49,898
1897	4,102	7,280	1919	25,020	74,482
1898	8,050	23,594	1920	[b]29,531	92,899
1899	9,682	10,550	1921	30,232	98,395
1900	4,103	5,891	1922	38,321	127,792
1901	2,945	4,630	1923	28,015	124,919
1902	19,305	37,616	1924	[b]61,579	140,253
1903	84,624	97,354	1925	35,664	116,105
1904	55,401	94,208	1926	34,806	119,999
1905	73,303	129,450	1927	[b]42,308	103,689
1906	31,400	75,800	1928	34,324	82,190
1907	37,512	118,066			
1908	18,653	47,665	Total value		$3,135,747

[a]Includes onyx and serpentine.
[b]Includes onyx.

ONYX and TRAVERTINE

Bibliography: State Mineralogist Reports XII–XV (inc.), XVII, XVIII. Bulletin 38.

Onyx and travertine are known to exist in a number of places in California, but there has been only a small and irregular production since the year 1896. In 1928 there were shipments from Kern, Alameda, Mono, and Solano counties with a slight decrease in both quantity and value, the figures of which are combined with marble. This material is used in terrazzo, auto gear-shift handles, bases for fountain-pen desk sets, and other ornamental purposes.

Onyx Production of California, by Years.

Production by years has been as follows:

Year	Value	Year	Value
1887	$900	1919	----------
1888	900	1920	*
1889	900	1921	$1,294
1890	1,500	1922	3,320
1891	2,400	1923	2,510
1892	1,800	1924	*
1893	27,000	1925	16,120
1894	20,000	1926	7,575
1895	12,000	1927	*
1896	24,000	1928	*
1918	*	Total value	$122,219

*See under Marble.

SANDSTONE

Bibliography: State Mineralogist Reports XII–XV, XVII, XVIII, XXI. Bulletin 38. U. S. Bur. of M., Bull. 124.

An unlimited amount of high-grade sandstone is available in California, but the wide use of concrete in buildings of every character, as well as the popularity of a lighter-colored building stone, has curtailed production in this branch of the mineral industry during recent years almost to the vanishing point. In 1928 a total of 134,100 cu. ft., valued at $43,250, was quarried in five counties, Los Angeles, Monterey, Napa, Siskiyou and Sonoma; compared with 22,900 cu. ft. and $205,400 in 1927. The material reported from Monterey County is in reality an indurated shale of the Monterey series, of a cream color and utilized as a building stone; and that from Sonoma is a stratified, altered andesite having the appearance of sandstone.

A large portion of the sandstone was sold for landscape work and used as stepping stones for walks and for fountains, walls, etc.

Sandstone Production of California, by Years.

Amount and value, so far as contained in the records of this Bureau, are presented herewith, with total value from 1887 to date:

Year	Cubic feet	Value	Year	Cubic feet	Value
1887	----------	$175,000	1909	79,240	$37,032
1888	----------	150,000	1910	165,971	80,443
1889	----------	175,598	1911	255,313	127,314
1890	----------	100,000	1912	66,487	22,574
1891	----------	100,000	1913	62,227	27,870
1892	----------	50,000	1914	111,691	45,322
1893	----------	26,314	1915	63,350	8,438
1894	----------	113,592	1916	17,270	10,271
1895	----------	35,373	1917	31,090	7,074
1896	----------	28,379	1918	900	400
1897	----------	24,086	1919	5,400	3,720
1898	----------	46,384	1920	10,500	2,300
1899	56,264	103,384	1921	10,150	2,112
1900	378,468	254,140	1922	900	1,100
1901	266,741	192,132	1923	7,000	13,000
1902	212,123	142,506	1924	6,700	3,600
1903	353,002	585,309	1925	14,704	14,362
1904	363,487	567,181	1926	34,100	17,500
1905	302,813	483,268	1927	22,900	205,400
1906	182,076	164,068	1928	134,100	43,250
1907	159,573	148,148			
1908	93,301	55,151	Total value	----------	$4,393,095

SERPENTINE

Bibliography: State Mineralogist Report XV. Bulletin 38.

Serpentine has not been produced in California to a very large extent at any time. A single deposit, that on Santa Catalina Island, has yielded the principal output to date. Some material was shipped from there in 1917 and 1918, being the only output recorded since 1907. It was used for decorative building purposes and for electrical switchboards. As there was but a single operator, the figures were combined with those of marble output for those years.

Serpentine Production of California by Years.

The following table shows the amount and value of serpentine from 1895 as recorded by this Bureau:

Year	Cubic feet	Value	Year	Cubic feet	Value
1895	4,000	$4,000	1904	200	$2,310
1896	1,500	6,000	1905		
1897	2,500	2,500	1906	847	1,694
1898	750	3,000	1907	1,000	3,000
1899	500	2,000	1917	[a]	[a]
1900	350	2,000	1918	[b]	[b]
1901	89	890	1919		
1902	512	5,065			
1903	99	800	Totals	12,347	$33,259

[a] Under 'Unapportioned.'
[b] See under Marble.

SLATE

Bibliography: State Mineralogist Reports XV, XVIII. Bulletin 38. U. S. Geol. Surv., Bull. 586. U. S. Bur. of Mines, Bull. 218.

Slate was first produced in California in 1889. Up to and including 1910 such production was continuous, but since then it has been irregular. Large deposits of excellent quality are known in the state, especially in El Dorado, Calaveras and Mariposa counties, but the demand has been light owing principally to competition of cheaper roofing materials.

'Slate' is a term applied to a fine-grained rock that has a more or less perfect cleavage, permitting it to be readily split into thin, smooth sheets. Varieties differ widely in color and have a considerable range in chemical and mineralogical composition. Excepting certain rare slates of igneous origin (of which the green slate of the Eureka quarry, El Dorado County, California, is an example) formed from volcanic ash or igneous dikes, slates have originated from sedimentary deposits consisting largely of clay. By consolidation, and the pressure of superimposed materials, clays become bedded deposits of shale. By further consolidation under intense pressure and high temperature incident to mountain-building forces, shales are metamorphosed to slates. The principal mineral constituents are mica, quartz, and chlorite, with smaller varying amounts of hematite, rutile, kaolin, graphite, feldspar, tourmaline, calcite, and others.

The color of slate is of economic importance. The common colors are gray, bluish gray, and black, though reds and various shades of green are occasionally found.

The permanency of slate for roofing is well known. It is stated that there are slate roofs in Pennsylvania and Maryland over 100 years old.

[1] "In England and Wales, and in France, many buildings constructed in the 15th and 16th centuries were roofed with slate, and the roofs are still in excellent condition. There is a record of a chapel in Bedford-on-Avon in Wiltshire, England, roofed with slate in the 8th century, and after 1200 years of climatic exposure is moss-covered but in good condition."

Contrary to the general impression, however, the major portion of the slate produced in the United States is used on the inside rather than the outside of buildings. Its interior uses include stationary washtubs, electrical switchboards, and blackboards.

A square of roofing slate is a sufficient number of pieces of any size to cover 100 square feet of roof, with allowance generally for a three-inch lap. The sizes of the pieces of slate making up a square range from 7 x 9 inches to 16 x 24 inches, and the number of pieces in a square ranges from 85 to 686. The Ferry Building, San Francisco, is roofed with Eureka slate from El Dorado County.

During 1928 there were shipments in California of 4075 tons of slate valued at $31,263 coming from two properties in El Dorado County and one in Riverside and Tuolumne counties. This was an increase over the 1927 output, which was 2686 tons and valued at $17,960. Practically all of this slate was crushed and used for roofing granules.

Total Production of Slate in California.

A complete record of amount and value of slate produced in California follows:

Year	Squares	Value	Year	Squares	Value
1889	4,500	$18,089	1906	10,000	$100,000
1890	4,000	24,000	1907	7,000	60,000
1891	4,000	24,000	1908	6,000	60,000
1892	3,500	21,000	1909	6,961	45,660
1893	3,000	21,000	1910	1,000	8,000
1894	1,800	11,700	1911		
1895	1,350	9,450	1915	1,000	5 000
1896	500	2,500	1916		
1897	400	2,800	1920	8	80
1898	400	2,800	1921		
1899	810	5,900	1922	*	*
1900	3,500	26,250	1923		
1901	5,100	38,250	1926		7,371
1902	4,000	30,000	1927		17,960
1903	10,000	70,000	1928		31,263
1904	6 000	50,000			
1905	4,000	40,000	Total value		$733,073

*Concealed under 'Unapportioned.'

MISCELLANEOUS STONE

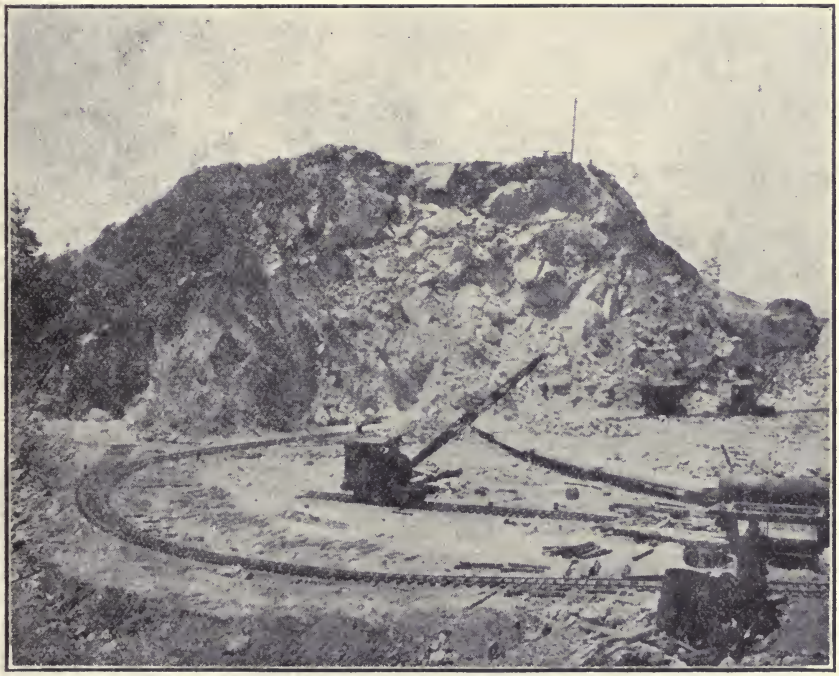
Bibliography: State Mineralogist Reports XII–XXIII (inc.). Bulletin 38; also annual statistical bulletins from 1915 to date.

'Miscellaneous stone' is the name used throughout this report as the title for that branch of the mineral industry covering crushed rock of all kinds, paving blocks, sand and gravel, and pebbles for grinding mills. The foregoing are very closely related from the standpoint of the producer; therefore it has been found to be most satisfactory to

[1] Bowles, O., Slate as a Permanent Roofing Material: U. S. Bur. of M., Reports of Investigations, Serial No. 2267, July, 1921, p. 4.

group these items as has been done in recent reports of this Bureau. So far as it has been possible to do so, crushed rock production has been subdivided into the various uses to which the product was put. It will be noted, however, a very large percentage of the output has been tabulated under the heading 'Unclassified.' This is necessary because of the fact that many of the producers have no way of telling to what specific use their rock was put (or at least the proportions to each use) after they have quarried and sold the same to distributors and contractors.

In addition to amounts produced by commercial firms, both corporations and individuals, there is hardly a county in the state but uses more or less gravel and broken rock on its roads. Of much of this,



Quarry of Webber Construction Co., at Crescent City, Del Norte County. Source of rock for breakwater construction. Photo by Walter W. Bradley.

particularly in the country districts, there is no definite record kept.

For the year 1928 the production of crushed rock remained practically the same as the preceding year, although there was a large decrease in its total value. Sand and gravel showed both an increase in tonnage and total value over the figures of 1927. This resulted in a total value of $17,332,110 in 1928 as compared with $18,911,194 in 1927, although the 1928 total tonnage showed an increase. The fact that building in the cities showed a decline and that there was considerable activity on highway and other large construction projects accounted for increased tonnage and decreased values.

As for some years past, Los Angeles County led all other counties by a wide margin, with an output valued at $5,622,815 (compared with

$6,292,078 in 1927); followed by San Diego with $1,284,741; Alameda third with $1,267,155; Contra Costa fourth with $590,792; Riverside fifth with $557,504; Calaveras sixth with $557,020; Butte seventh with $556,310; Santa Clara eighth with $467,555; followed in order by Sacramento, Del Norte, Siskiyou, Fresno, San Benito, Ventura, San Bernardino, and Marin.

Paving Blocks.

During 1928 paving blocks were produced in Riverside and San Mateo counties. The Riverside County production was Silax used in tube mill linings at cement plants.

Large slingrock from Webber Construction Co.'s quarry for Crescent City Breakwater, Del Norte County. Photo by Walter W. Bradley.

The paving block industry has decreased materially of recent years, practically to the vanishing point, because of the increased construction of smoother pavements demanded by motor vehicle traffic. The blocks made in Solano County were of basalt; those from Sonoma are of basalt, andesite, and some trachyte, while those from Madera, Placer, Riverside, San Bernardino, and San Diego are of granite; and those from San Mateo County a sandstone.

The amount and value of paving block production, annually, since 1887 has been as follows:

Year	Amount M	Value	Year	Amount M	Value
1887	*10,000	$350,000	1909	4,503	$199,803
1888	10,500	367,500	1910	4,434	198,916
1889	7,303	297,236	1911	4,141	210,819
1890	7,000	245,000	1912	11,018	578,355
1891	5,000	150,000	1913	6,364	363,505
1892	*3,000	96,000	1914	6,053	270,598
1893	2,770	96,950	1915	3,285	171,092
1894	2,517	66,981	1916	1,322	54,362
1895	2,332	73,338	1917	938	38,567
1896	4,161	77,584	1918	372	17,000
1897	1,711	35,235	1919	27	1,350
1898	1,144	21,725	1920	63	3,155
1899	305	7,861	1921	4	280
1900	1,192	23,775	1922	72	3,924
1901	1,920	41,075	1923	15	880
1902	3,502	112,437	1924	11	935
1903	4,854	134,642	1925	27	1,350
1904	3,977	161,752	1926		
1905	3,408	134,347	1927	41	2,057
1906	4,203	173,432	1928	25	1,658
1907	4,604	199,347			
1908	7,660	334,780	Totals	135,768	$5,319,603

*Figures for 1887-1892 (inc.) are for Sonoma County only, as none are available for other counties during that period though Solano County quarries were then also quite active.

Grinding Mill Pebbles.

Production of pebbles for tube and grinding mills began commercially in California in 1915. Owing to the decreased imports and higher prices of Belgium and other European flint pebbles, due to the war, there was a serious inquiry for domestic sources of supply. In 1916 and 1917 shipments totaled in excess of 20,000 tons per year; but they have since dropped to an insignificant figure. San Diego County has been the principal contributor, with some also from Fresno and Sacramento. Shipments have been made to metallurgical plants in California, Nevada, Montana and Utah.

Imports in 1928 amounted to 14,035 long tons, valued at $144,313 compared with 13,563 long tons and $93,658 in 1927.

California output for 1928 was 372 tons, valued at $2,408, an increase from the 1927 figures.

The amount and value of grinding mill pebbles, annually, follows:

Year	*Tons*	*Value*
1915	340	$2,810
1916	20,232	107,567
1917	21,450	90,538
1918	8,628	61,268
1919	2,607	19,272
1920	2,104	17,988
1921	247	1,418
1922	1,571	7,628
1923	2,650	14,936
1924	434	2,969
1925	215	1,385
1926	102	612
1927	288	1,800
1928	372	2,408
Totals	61,240	$262,599

Sand and Gravel.

A considerable part of the gravel excavated is passed through grading and washing plants, and the material over 2 inches in size is crushed. Much of it is utilized in concrete mixtures. Most of the gravel used for road surfacing and repairs as well as that for railroad ballast is creek-run or pit-run material which is spread upon the roads without undergoing any grading or washing.

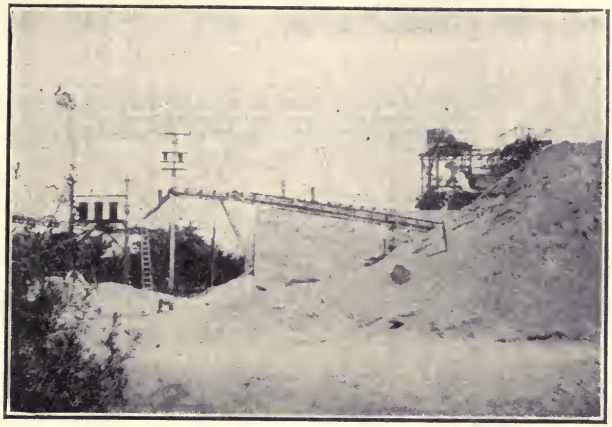
The distribution of the 1928 output of sand and gravel, by counties, is given in the following table:

County	*Tons*	*Value*
Alameda	[a] 1,590,454	$1,024,196
Butte	70,300	45,900
Colusa	34,000	16,500
Contra Costa	[a] 148,807	90,824
Del Norte	28,481	34,400
Fresno	261,171	179,745
Glenn	484,815	101,889
Humboldt	50,486	37,570
Imperial	154,611	90,777
Kern	88,409	41,135
Kings	800	1,240
Lake	27,900	18,695
Lassen	52,870	20,589
Los Angeles	7,507,295	3,324,572
Madera	90,680	51,020
Marin	13,333	20,000
Mariposa	39,884	29,913
Mendocino	78,235	28,825
Modoc	152,013	29,440
Monterey	[a] 221,727	210,489
Napa	47,873	45,607
Orange	309,618	170,122
Placer	8,000	4,000
Plumas	12,812	6,013
Riverside	[a] 65,057	114,740
Sacramento	[a] 530,615	364,531
San Bernardino	252,826	173,358
San Diego	[a] 1,867,933	1,179,475
San Joaquin	367,703	63,444
San Luis Obispo	26,264	11,263
San Mateo	9,240	5,542
Santa Clara	637,989	354,324
Shasta	32,572	23,990
Sierra	1,408	1,403
Siskiyou	415,133	315,760
Solano	13,000	2,000
Sonoma	95,666	48,450
Stanislaus	335,831	186,350
Tehama	4,956	2,669
Trinity	7,383	12,084
Tulare	101,903	104,303
Tuolumne	1,000	250
Ventura	[a] 449,439	326,195
Yuba	304,255	138,384
Merced, San Francisco,[a] Santa Barbara, Santa Cruz, Sutter and Yolo *	266,758	180,498
Totals	17,261,505	$9,232,474

[a] Includes molding sand.

* Combined to conceal output of a single operator in each.

Included in the above is a total of 60,523 tons of molding sand, valued at $131,349 f.o.b. pit from two operators in San Diego County, and one each in Alameda, Contra Costa, Monterey, Riverside, Sacramento, San Francisco, and Ventura counties. This item is each year assuming a more important position in the commercial mineral list of California. The 1927 figures totaled 46,930 tons and $128,752.



Plant of Russian River Gravel Co., Healdsburg, Cal.

Crushed Rock.

To list the kinds and varieties of rock utilized commercially under this heading would be to run almost the entire gamut of the classification scale. Much depends on the kind available in a given district. Those which give the most satisfactory service are the basalts and other hard, dense, igneous rocks which break with sharp, clean edges. In

Sand plant of John Freitas, Ukiah, Cal.

many localities, river-wash boulders form an important source of such material. In such cases, combined crushing and washing plants obtain varying amounts of sand and gravel along with the crushed sizes. In Sacramento and Butte counties the tailings piles from the gold dredgers are the basis of like operations.

The values given are based on the selling price, f o. b. cars, barges, or trucks, at the quarry.

Crushed Rock Production, by Counties, for 1928

County	Macadam and ballast		Rubble and riprap		Concrete		Unclassified		Total	
	Tons	Value	Tons	Value	Tons	Value	Tons	Value	Tons	Value
Alameda	19,305	$19,746			168,622	$186,328	[1]53,189	$36,885	241,116	$242,959
Alpine	5,600	2,800							5,600	2,800
Amador	1,450	700	240,000	$180,000	9,200	9,200			250,650	189,900
Butte	357,808	360,298			3,500	3,410	160,293	146,693	521,601	510,401
Calaveras	6,020	6,020			835,000	475,000	*		841,020	481,020
Contra Costa	108,699	78,749	208,422	33,112	16,781	16,991	458,460	371,116	792,362	499,968
Del Norte	179,740	346,680							179,740	346,680
El Dorado	22,416	17,455							22,416	17,455
Fresno	60,000	35,000			51,822	66,715	101,000	80,800	212,822	182,515
Humboldt	96,145	216,421					*		96,145	216,421
Imperial			45,948	8,013					45,948	8,013
Inyo	54,245	44,831							54,245	44,831
Kern	1,000	1,000			*				1,000	1,000
Lake	2,340	700							2,340	700
Lassen	41,712	48,850			1,760	3,960			43,472	52,810
Los Angeles	122,047	70,903	50,000	50,000	1,157,261	675,344	[2,3]1,964,194	1,501,996	3,293,502	2,298,243
Marin	13,666	22,000	*				*		13,666	22,000
Mariposa							[2]23,575	38,160	23,575	38,160
Mendocino	7,353	11,595							7,353	11,595
Napa	90,096	60,152			*				90,096	60,152
Nevada							2,000	4,000	2,000	4,000
Orange					66,155	53,756	*		66,155	53,756
Placer	8,820	11,466	8,283	7,630					17,103	19,096
Plumas	36,109	22,111							36,109	22,111
Riverside	25,000	78,750	352,666	356,914			[2,3]1,760	5,600	379,426	441,264
Sacramento	2,505	1,252	2,970	1,188			[3]175,005	86,804	180,480	89,244
San Diego	10,000	6,500	*		*		*		10,000	6,500
San Luis Obispo	142,080	99,456	1,260	462					143,340	99,918
San Mateo	172,027	173,900	67,434	51,440	17,548	19,437	666	1,125	257,675	245,902
Santa Clara	1,333	1,000					178,074	112,231	179,407	113,231
Santa Cruz	24,030	14,400	*		*		*		24,030	14,400
Shasta	[4]256,672	113,020	*						256,672	113,020
Siskiyou	[5]80,666	48,547	*		2,786	2,680			83,452	51,227
Sonoma	64,068	62,678	*		*				64,068	62,678
Tehama	8,509	9,276							8,509	9,276
Tuolumne	3,625	1,400					1,230	7,440	4,855	8,840

San Benito, Santa Barbara, Sierra, Stanislaus, Ventura and Yuba*	515,955	310,821							515,955	310,821
Marin, San Bernardino, San Diego, Santa Barbara, Santa Cruz, Shasta, Siskiyou, Sonoma, Tulare*			164,246	208,422					164,246	208,422
Kern, Napa, San Benito, Santa Barbara, San Diego, San Bernardino, Santa Cruz, Sonoma, Stanislaus, Tulare*					392,952	318,641			392,952	318,641
Calaveras[2], Humboldt, Marin, Orange[3], San Benito[3], San Bernardino, San Diego[3], San Francisco, Santa Barbara, Santa Cruz, Solano, Stanislaus*							685,186	675,600	685,186	675,600
Totals	2,541,041	$2,298,477	1,141,229	$897,181	2,723,387	$1,871,462	3,804,632	$3,068,450	10,210,289	$8,095,570

* Combined to conceal the output of a single operator in each.
[1] Includes red roofing granules.
[2] Includes granules for roofing and terrazzo.
[3] Includes decomposed granite.
[4] Includes slag.
[5] Includes volcanic cinder.

Miscellaneous Stone Production of California, by Years.

The amount and value, annually, of crushed rock (including macadam, ballast, rubble, riprap, and that for concrete), and sand and gravel, since 1893, follow:

Crushed Rock, Sand and Gravel, by Years

Year	Tons	Value	Year	Tons	Value
1893	371,100	$456,075	1912	8,044,937	$4,532,598
1894	661,900	664,838	1913	9,817,616	4,823.056
1895	1,254,688	1,095,939	1914	9,288,397	3,960,973
1896	960,619	839,884	1915	10,879,497	4,609,278
1897	821,123	600,112	1916	9,951,089	4,009,590
1898	1,177,365	814,477	1917	8,069,271	3,505,652
1899	964,898	786,892	1918	6,641,144	3,325,889
1900	789,287	561,642	1919	6,919,188	3,678,322
1901	530,396	641,037	1920	9,792,122	6,782,414
1902	2,056,015	1,249,529	1921	10,914,145	7,834,940
1903	2,215,625	1,673,591	1922	13,049,644	10.366,231
1904	2,296,898	1,641,877	1923	19,840,301	15,379,338
1905	2,624,257	1,716,770	1924	21,451,129	15,962,476
1906	1,555,372	1,418,406	1925	23,819,137	17,407,113
1907	2,288,888	1,915,015	1926	24,987,606	19,859,261
1908	3,998,945	3,241,774	1927	25,126,691	18.912,994
1909	5,531,561	2,708,326	1928	27,471,794	17,328,044
1910	5,827,828	2,777,690			
1911	6,487,223	3,610,357	Totals	268,477,696	$190,692,610

A comparison of the above table of annual production of these materials with the similar table for cement (see *ante*), reveals the fact that the important growth of the crushed rock and gravel business has been coincident with the rapid development of the cement industry from the year 1902.

CHAPTER FIVE

INDUSTRIAL MATERIALS

Bibliography: State Mineralogist Reports XII–XXIII (inc.). Bulletin 38. Min. & Sci. Press, Vol. 114, March 10, 1917. Spurr and Wormser, "Marketing of Metals and Minerals." "Non-Metallic Minerals," by R. B. Ladoo. See also under each substance.

The following mineral substances have been arbitrarily arranged under the general heading of 'Industrial Materials,' as distinguished from those which have a clearly defined classification, such as metals, salines, structural materials, etc.

These materials, many of which are mineral earths, are, with four or five exceptions, as yet produced on a comparatively small scale. The possibilities of development along several of these lines are large, and with increasing transportation and other facilities, together with steadily growing demands, the future for this branch of the mineral industry in California is promising. There is scarcely a county in the state but might contribute to the output.

Up to within the last few years, at least, production has been in the majority of instances dependent upon more or less of a strictly local market, and the annual tables show the results of such a condition, not only in the widely-varying amounts of a certain material produced from year to year, but in widely-varying prices of the same material.

The more important of these minerals thus far exploited, so far as shown by value of the output, are limestone, mineral water, pyrites, pottery clays, diatomaceous earth, gypsum, talc, dolomite, fuller's earth.

This group as a whole showed an increase in the total value to $5,699,963 in 1928 from $5,258,068 for 1927.

The following table gives the comparative figures for the amounts and values of industrial minerals produced in California during the years 1927 and 1928:

Substance	1927		1928		Increase+ Decrease— Value
	Amount	Value	Amount	Value	
Barytes	17,993 tons	$90,617	13,406 tons	$55,888	$34,729—
Clay (pottery)	867,419 tons	872,661	887,807 tons	1,394,950	522,280+
Dolomite	45,976 tons	79,422	38,379 tons	85,342	5,929+
Feldspar	10,932 tons	86,101	14,628 tons	93,745	7,644+
Fuller's earth	13,018 tons	154,764	53,323 tons	501,743	346,979+
Gems		7,035		22,200	15,165+
Gypsum	94,630 tons	292,090	104,790 tons	200,567	91,523—
Limestone	699,790 tons	663,957	127,895 tons	397,935	266,022—
Mineral water	16,644,423 gals.	1,487,183	25,049,002 gals.	1,304,969	182,214—
Pumice and volcanic ash	13,779 tons	168,896	10,440 tons	105,055	63,841—
Pyrite	130,910 tons	564,823	90,566 tons	400,627	164,196—
Silica (sand and quartz)	24,636 tons	94,762	14,814 tons	66,670	28,092—
Soapstone and talc	16,218 tons	164,744	18,668 tons	251,372	86,628+
Unapportioned		[1]651,013		[2]818,900	167,887+
Total value		$5,378,068		$5,699,963	
Net increase					$321,895

[1] Includes asbestos, diatomaceous earth, graphite, lithia, mineral paint, shale oil, sillimanite-andalusite-cyanite group.
[2] Includes asbestos, diatomaceous earth, lithia, mineral paint, sillimanite-andalusite-cyanite group.

ASBESTOS

Bibliography: State Mineralogist Reports XII–XIX (inc.), XXII. Bulletins 38, 91. Canadian Dept. of M., Mines Branch Bulletin 69. Min. & Sci. Press, April 10, 1920, pp. 531–533. Eng. & Min. Jour.-Press, Vol. 113, pp. 617–625, 670–677. Asbestology, Vol. 5, No. 7, July, 1927.

In 1928 there was a small tonnage of crude asbestos ore and fibre produced in Lake County, but owing to a single operator, the figures are concealed under the 'Unapportioned' item.

The future of asbestos mining in California is dependent largely upon the development of uses in quantity for the short-fibre mill grades, and for the amphibole variety. There are apparently large resources of such material that can be made available. Some spinning-grade fibre has also been found in this state, notably in Nevada, Calaveras, and Monterey counties, but the commercial yield to date has been small. There are extensive serpentine areas in the Coast Ranges, in the Klamath Mountains, and in several sections of the Sierra Nevada which are within the range of possible asbestos producers, as chrysotile is a fibrous form of serpentine. These localities all yielded chromite in greater or less amounts during the World War period.

Three-quarters of the world's supply of asbestos was for many years produced by Canada.

At present, Rhodesia furnishes 60 per cent of the long fibre, though Canada in addition to its long fibre still accounts for practically the entire output of lower grades.

Asbestos Production of California, by Years.

Total amount and value of asbestos production in California since 1887, as given in the records of this Bureau, are as follows:

Year	Tons	Value	Year	Tons	Value
1887	30	$1,800	1909	65	$6,500
1888	30	1,800	1910	200	20,000
1889	30	1,800	1911	125	500
1890	71	4,260	1912	90	2,700
1891	66	3,960	1913	47	1,175
1892	30	1,830	1914	51	1,530
1893	50	2,500	1915	143	2,860
1894	50	2,250	1916	145	2,380
1895	25	1,000	1917	136	10,225
1896			1918	229	9,903
1897			1919		
1898	10	200	1920	131	6,240
1899	30	750	1921	410	19,275
1900	50	1,250	1922	50	1,800
1901	110	4,400	1923	20	200
1902			1924	70	4,750
1903			1925		
1904	10	162	1926	25	1,650
1905	112	2,625	1927		
1906	70	3,500	1928	13	1,160
1907	70	3,500			
1908	70	6,100	Totals	2,864	$136,535

*Annual details concealed under 'Unapportioned.'

BARYTES

Bibliography: State Mineralogist Reports XII, XIV, XV, XVII, XXI, Bulletin 38. Eng. & Min. Jour.-Press, Vol. 114, p. 109, July 15, 1922; Vol. 115, pp. 319–324, Feb. 17, 1923.

Commercial shipments of crude barytes in California in 1928 amounted to a total of 13,406 tons, valued at $55,888 f.o.b. rail-shipping point, being a marked decrease in both quantity and value over the 1927 figures of 17,993 tons and $90,617. The 1928 yield came from properties in Mariposa and Santa Barbara counties, and was consumed principally in the manufacture of lithopone, although some was sold for use in heavy-gravity, oil-well drilling mud.

More than half of the total tonnage of barytes utilized in the United States is taken in the manufacture of lithopone, which is a chemically-prepared white pigment containing approximately 70% barium sulphate and 30% zinc sulphide. This is one of the principal constituents of 'flat' wall paints. Other important uses for barytes, after washing and grinding, are as an inert pigment and filler in paint, paper, linoleums, oilcloth and rubber manufacture, and in the preparation of a number of chemicals including barium binoxide, carbonate, chloride, nitrate, and the sulphate precipitated, or 'blanc fixe.'

Present quotations for barytes vary from $7 to $9 per ton, crude, f. o. b. rail-shipping point, depending on quality. Most baryte has to be washed and acid treated to remove iron stains or other impurities before being suitable for paint use.

Known occurrences of this mineral in California are located in Inyo, Los Angeles, Mariposa, Monterey, Nevada, San Bernardino, Shasta and Santa Barbara counties. The deposit at El Portal, in Mariposa County, has given the largest commercial production to date, in part witherite (barium carbonate, $BaCO_3$). Witherite has also been found in Shasta County, but no shipments have yet been made from the deposit.

Total Barytes Production of California.

The first recorded production of barytes in California, according to the statistical reports of the State Mining Bureau, was in 1910. The annual figures are as follows:

Year	Tons	Value	Year	Tons	Value
1910	860	$5,640	1920	3,029	$20,795
1911	309	2,207	1921	901	4,809
1912	564	2,812	1922	3,370	18,925
1913	1,600	3,680	1923	2,925	16,058
1914	2,000	3,000	1924		
1915	410	620	1925		
1916	1,606	5,516	1926	4,978	38,165
1917	4,420	25,633	1927	17,993	90,617
1918	100	1,500	1928	13,406	55,888
1919	1,501	18,065			
			Totals	59,972	$313,930

CLAY (Pottery)

Bibliography: State Mineralogist Reports I, IV, IX, XII–XV, XVIII–XXIII (inc.). Bulletins 38, 99. Preliminary Report No. 7. U. S. Bureau of Standards, Tech. Paper No. 262.

At one time or another in the history of the state, pottery clay has been mined in thirty-three of its counties. Of these, 17 contributed in 1928. In this report, 'pottery clay' refers to all clays used in the manufacture of red and brown earthenware, china and sanitary ware, flower pots, floor, faience and ornamental tiling, architectural terra cotta, sewer pipe, drain and roof tile, etc., and the figures for amount and value are relative to the crude material at the pit, without reference to whether the clay was sold in the crude form or was immediately used in the manufacture of any of the above finished products by the producer. It does not include clay used in making brick and hollow building blocks.

There are many other important uses for clays besides pottery manufacture. Among these may be enumerated paper, cotton goods, and chemicals. Being neutral, clay does not have an injurious effect upon other constituents used in the manufacture of such articles. In paper making, clay is used as a filler in news and similar grades, and as a coater or glazer in the more highly-finished art papers. A large part of the china clay used in the United States is imported from England. Clays of the montmorillonite and halloysite group ('rock soap') are being utilized successfully in the manufacture of soaps.

During 1928 a total of 60 producers in 17 counties reported an output of 887,807 short tons of pottery clay, having a total value of $1,394,950 f. o. b. rail-shipping point, for the crude material, as compared with the 1927 production of 867,419 tons worth $872,661.

Because of the fact that a given product often requires a mixture of several different clays, and that these are not all found in the same pit, it is necessary for most clay-working plants to buy some part of their raw materials from other localities. For these reasons, in compiling the clay industry figures, much care is required to avoid duplications. So far as we have been able to segregate the figures, from the data sent in by the operatives, we have credited the clay output to the counties from which the raw material originated; and have deducted tonnages used in brick manufacture, as bricks are classified separately, herein.

A tabulation of the direct returns from the producers, by counties, for the year 1928 is shown herewith:

Pottery Clay in 1928

County	Tons	Value	Used in the manufacture of
Alameda	27,189	$17,071	Architectural terra cotta; chimney, drain and sewer pipe; faience, floor and roofing tile; garden furniture and various.
Amador	96,209	116,000	Architectural terra cotta, fire clay products and refractories, chimney and sewer pipe, drain, floor and roofing tile and various.
Los Angeles	99,781	55,539	Architectural terra cotta, conduit, segment blocks and liners, red earthenware, refractories, drain, chimney and sewer pipe, faience, floor and roofing tile, art pottery and various.
Orange	98,392	87,245	Stoneware, refractories, drain, faience, floor and roofing tile and various.
Placer	110,353	163,644	Architectural terra cotta, drain, chimney and sewer pipe; faience, floor and roofing tile, red earthen ware, refractories and various.
Riverside	115,538	543,671	Conduits, sewer and drain pipe, red earthenware, faience, floor and roofing tile, refractories and various.
San Bernardino	2,190	12,215	Floor and roofing tile, art pottery, refractories and various.
San Diego	[2]33,396	63,898	Sewer and drain pipe, faience, floor and roofing tile, sanitary ware and various.
Santa Clara	3,058	2,063	Sewer pipe, art pottery, drain, faience, floor and roofing tile, and various.
Ventura	[1]238,914	238,910	Drain and roofing tile and oil well mudding.
Contra Costa, Kern[1], Merced, Mono, Monterey and Sacramento*	62,787	94,694	Architectural terra cotta; chimney drain and sewer pipe, flue lining, faience, floor and roofing tile, oil well mudding and various.
Totals	887,807	$1,394,950	

* Combined to conceal output of a single operator in each.
[1] Includes clay and shale for oil well mudding.
[2] Includes "Cornwall stone."

Pottery Clay Products.

The value of the various pottery clay products made in California during 1928 totaled $14,767,848 compared with $14,739,689 in 1927, their distribution being shown in the following tabulation:

Products	*Number of producers*	*Tons*	*Value*
Architectural terra cotta, chimney pipe and flue lining	10	23,284	$2,247,803
Drain pipe	13	7,344	124,079
Sewer pipe	7	95,161	2,475,638
Roofing tile	24	85,795	1,641,992
Chinaware, semi-vitreous tableware	4	-----	598,791
Sanitary ware	5	-----	2,730,537
Red earthenware	7	-----	249,812
Stoneware and chemical stoneware	5	-----	341,310
Floor, faience, mantel, glazed, and hand-made tile	31	-----	3,228,889
Electrical porcelain	4	-----	483,091
Ground fire clay, fire cement, etc	6	4,380	50,871
Miscellaneous: art pottery, art tile, bath tile, decorative stands and tile, conduit pipe, segment blocks, garden furniture and pottery, glass-tank blocks, radiance and stove backs, and various	18	-----	595,035
Total value			$14,767,848

Important increases were shown in flat tile (floor, faience, mantel, etc.), sanitary ware, red earthenware, with decreases by architectural terra cotta, chimney pipe, sewer pipe, roofing and miscellaneous group.

Pottery Clay Production of California, by Years.

Amount and value of crude pottery clay output in California since 1887 are given in the following table:

Year	Tons	Value	Year	Tons	Value
1887	75,000	$37,500	1908	208,042	$325,147
1888	75,000	37,500	1909	299,424	465,647
1889	75,000	37,500	1910	249,028	324,099
1890	100,000	50,000	1911	224,576	252,759
1891	100,000	50,000	1912	199,605	215,683
1892	100,000	50,000	1913	231,179	261,273
1893	24,856	67,284	1914	179,948	167,552
1894	28,475	35,073	1915	157,866	133,724
1895	37,660	39,685	1916	134,636	146,538
1896	41,907	62,900	1917	166,298	154,602
1897	24,592	30,290	1918	112,423	166,788
1898	28,947	33,747	1919	135,708	245,019
1899	40,600	42,700	1920	203,997	440,689
1900	59,636	60,956	1921	225,120	362,172
1901	55,679	39,144	1922	277,232	473,184
1902	67,933	74,163	1923	376,863	697,841
1903	90,972	99,907	1924	417,928	651,857
1904	84,149	81,952	1925	537,587	674,376
1905	133,805	130,146	1926	801,461	806,509
1906	167,267	162,283	1927	867,419	872,661
1907	160,385	254,454	1928	887,807	1,394,950
			Totals	8,466,010	$10,710,254

DIATOMACEOUS EARTH

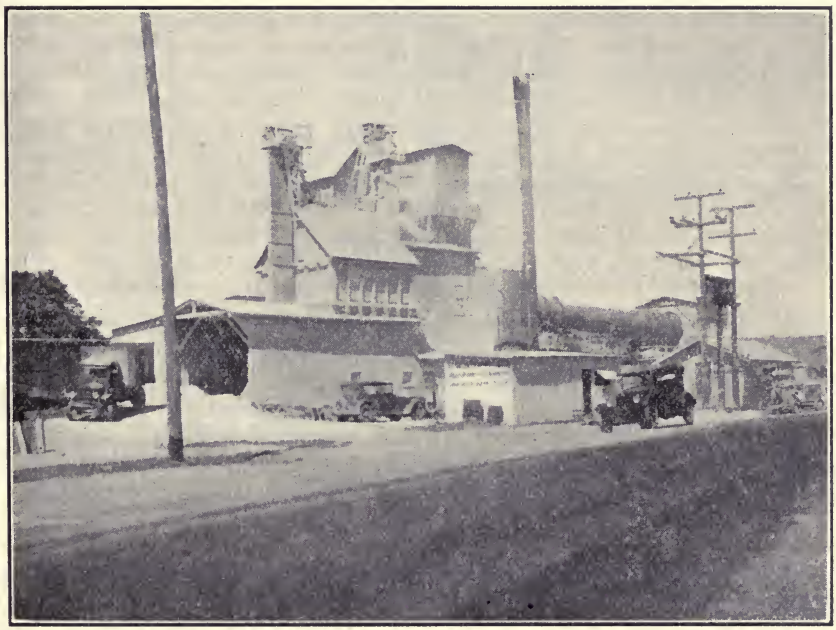
Bibliography: State Mineralogist Reports II, XII–XV (inc.), XVII–XXII (inc.). Bulletins 38, 67, 91. Am. Inst. Min. Eng. Bull., 104, August, 1915, pp. 1539–1550. U. S. Bur. of Mines, Rep. of Investigations: Serial No. 2431, Jan., 1923. Eng. & Min. Jour.-Press, Vol. 115, pp. 1152–1154, June 30, 1923.

Infusorial and diatomaceous earths—sometimes called tripolite—are very light and extremely porous, chalk-like materials composed of pure silica (chalk, being calcareous) which have been laid down under water and consist of the remains of microscopical infusoria and diatoms. The former are animal remains, and the latter are from plants. The principal commercial use of diatomaceous earth (also called 'diatomite') is as an absorbent. It is also employed in the manufacture of scouring soap and polishing powders; for filtration purposes; in making some classes of refractory brick; and as an insulating medium both in heating and refrigeration. It is a first-class nonconductor of heat, where high temperatures are employed, such as around steel and gas plants and power houses. In such cases, it is built in as an insulating layer in furnace walls. In Germany, under the name 'kieselguhr,' it was used as an absorbent for nitroglycerine in the early manufacture of dynamite.

As a nonconductor of heat it has been used alone or with other materials as a covering for boilers, steam pipes and safes, and in fireproof cement. It is used largely by paint manufacturers as a wood filler. Boiled with shellac it is made into records for talking machines. It has been used for absorbing liquid manures so that they could be utilized as fertilizers, and as a source of silica in making water-glass as well as in the manufacture of cement, tile glazing, artificial stone, ultramarine and other pigments of aniline and alizarine colors, paper filling, sealing wax, fireworks, hard-rubber objects, matches, and paper maché, and

for solidifying bromine. For making insulating brick the material is sawed into blocks, and for all other purposes it is ground and screened.

The most important deposits in California thus far known are located in Monterey, Orange, San Luis Obispo, and Santa Barbara counties. The Santa Barbara material is diatomaceous and is of a superior quality, particularly for filtration uses which bring the higher prices. Infusorial or diatomaceous earths are also found in Fresno, Kern, Los Angeles, Plumas, San Benito, San Bernardino, San Joaquin, Shasta, Sonoma, and Tehama counties.



Diatomaceous earth plant of Pacatome Company at Bradley, Monterey County. Photo by Walter W. Bradley.

As almost 90% of the output in California is from a single operator, we have concealed the exact figures under the 'Unapportioned' item in the state and county totals. There were seven operators in 1928 in Los Angeles, Monterey, Santa Barbara, and Shasta counties, the shipments showing an increase in tonnage and value compared with 1927.

The material shipped was utilized for insulation, filtration, paint pigment, cement admixture, and for clarification of gasoline and kerosene.

Total Production of Diatomaceous Earth in California.

The first recorded production of these materials in California occurred in 1889; total amount and value of output, to date, are as follows:

Year	Tons	Value	Year	Tons	Value
1889	39	$1,335	1910	1,843	$17,617
1890			1911	2,194	19,670
1891			1912	4,129	17,074
1892			1913	8,645	35,968
1893	50	2,000	1914	12,840	80,350
1894	51	2,040	1915	12,400	62,000
1895			1916	15,322	80,619
1896			1917	24,301	127,510
1897	5	200	1918	35,963	189,459
1898			1919	40,200	217,800
1899			1920	60,764	1,056,260
1900			1921		
1901			1922	*90,739	1,016,675
1902	422	2,532	1923		
1903	2,703	16,015	1924	*193,064	5,729,736
1904	6,950	112,282	1925		
1905	3,000	15,000	1926		
1906	2,430	14,400	1927	* 275,403	1,995,923
1907	2,531	28,948	1928		
1908	2,950	32,012			
1909	500	3,500	Totals	799,438	$10,876,955

*Annual details concealed under 'Unapportioned.'

DOLOMITE

Bibliography: Reports XV, XVII–XXII (inc.). Bulletins 67, 91.

The production of dolomite for the year 1928 totaled 38,739 tons valued at $85,342, being a decrease in value from the 1927 figures which were 45,976 tons at $79,422. The 1928 output came from a single quarry each in Inyo, Monterey and Tuolumne counties. The material shipped was utilized for steel furnace flux and refractories, and for manufacture of CO_2. Some previously has been used for burned dolomite lime, for stucco dash-coat, and terrazzo.

Dolomite Production of California, by Years.

Previous to the 1915 statistical report of the State Mining Bureau, dolomite was included under limestone, as the two minerals are closely related chemically; but since dolomite, as such, has been found to have certain distinctive applications, we here give it a separate classification.

Amount and value of the output of dolomite, annually, have been as follows:

Year	Tons	Value
1915	4,192	$14,504
1916	13,313	46,566
1917	27,911	66,416
1918	24,560	79,441
1919	24,502	67,953
1920	42,388	132,791
1921	31,195	99,155
1922	52,409	114,911
1923	69,519	142,615
1924	28,843	71,271
1925	42,852	104,900
1926	68,640	119,313
1927	45,976	79,442
1928	38,379	85,342
Totals	514,679	$1,224,620

FLUORSPAR

Bibliography: State Mineralogist Reports XVII, XVIII. Bulletins 67, 91. Eng. & Min. Jour.-Press, Vol. 177, pp. 489–492, Mar. 22, 1924.

Fluorspar, or calcium fluoride, CaF_2, is one of the most important non-metallic minerals from an industrial standpoint. About 80% of the commercial mineral is prepared in the 'gravel' form and utilized as a flux in the manufacture of steel, for which use no substitute has yet been found. In the United States, under normal business conditions, the consumption for that purpose is 125,000 to 150,000 tons annually. Fluorspar is also used in aluminum smelting, and in the manufacturing of enameled ware, glazed tile and brick, opalescent glass and certain chemicals, particularly hydrofluoric acid and its derivatives. The mineral is marketed in three forms: lump, gravel, and ground.

According to the U. S. Bureau of Foreign and Domestic Commerce, imports of fluorspar into the United States in 1928 amounted to 42,128 long tons, valued at $408,700, and came principally from England, with smaller amounts from British South Africa, Italy, China and Netherlands. The 1928 figures were a decrease from the previous year when 63,853 short tons worth $595,185 were imported.

In California deposits have been reported in Los Angeles, Mono, Riverside and San Bernardino counties, but no commercial production has resulted except in 1917–1918, when a total of 79 tons valued at $991 was shipped from Riverside County.

The Tariff Act of 1922 places a duty of $5.60 per ton on foreign importations of fluorspar.

Present quotations (Engineering and Mining Journal, New York) are not less than 85% CaF_2 and not over 5% SiO_2, $18; foundry lump, $20.

FELDSPAR

Bibliography: State Mineralogist Reports XV, XVII, XVIII, XXI. Bulletins 67, 91. U. S. Bureau of Mines, Bulletin 92. Eng. & Min. Jour.-Press, Vol. 115, pp. 535–538, Mar. 24, 1923.

Feldspar was produced by five operators in four counties (Imperial Kern, Riverside and San Diego) during 1928, to the amount of 14,628 tons, valued at $93,745, being an increase both in quantity and value over the 1927 figures, which were 10,932 tons and $86,101.

The requirements of the pottery trade demand that in general the percentage of free silica associated with the feldspar be less than 20%, and in some cases the potters specify less than 5%. An important factor, also, is the iron-bearing minerals frequently present in pegmatites and granites, such as biotite (black mica), garnet, hornblende, and black tourmaline. Feldspar for pottery uses should be practically free of these. The white, potash-mica, muscovite, is not particularly objectionable except that, being in thin, flexible plates, it does not readily grind to a fineness required for the feldspar.

Present quotations are from $5 to $9 per ton, crude, according to quality.

The most important developments quantitatively in the feldspar resources of California have thus far taken place in San Diego and

Riverside counties, where large deposits of massive, high-grade spar are being opened up. These deposits are unusually free from black mica and other deleterious iron-bearing minerals objectionable in pottery work. The important producing districts are near Lakeside and Campo, in San Diego County, and near Lakeview, Murrietta, and Elsinore, in Riverside County. Other deposits which give promise are reported from Inyo, Kern and San Bernardino counties. No recent shipments have been reported from Monterey and Tulare counties, formerly important sources.

Total Feldspar Production of California.

Total amount and value of feldspar production in California since the inception of the industry are given in the following table, by years:

Year	Tons	Value	Year	Tons	Value
1910	760	$5,720	1920	4,518	$26,189
1911	740	4,560	1921	4,349	28,343
1912	1,382	6,180	1922	4,587	37,109
1913	2,129	7,850	1923	11,100	81,800
1914	3,530	16,565	1924	9,055	68,112
1915	1,800	9,000	1925	8,165	59,615
1916	2,630	14,350	1926	7,300	56,400
1917	11,792	46,411	1927	10,932	86,101
1918	4,132	22,061	1928	14,628	93,745
1919	1,272	12,965			
			Totals	105 801	$683,071

FULLER'S EARTH

Bibliography: State Mineralogist Reports XIV, XVII, XVIII, XXI. Bulletins 38, 91. U. S. Bureau of Mines, Bulletin 71. Eng. & Min. Jour.-Press, Vol. 121, pp. 837–842, May 22, 1926.

Fuller's earth includes many kinds of unctuous clays. It is usually soft, friable, earthy, nonplastic, white and gray to dark green in color, and some varieties disintegrate in water. In California, fuller's earth has been used in clarifying both refined mineral and vegetable oils, and for special chemical purposes; although its original use was in fulling wool, as the name indicates. Production has come mainly from Calaveras and Solano counties, with other deposits noted also in Riverside, Fresno, Inyo and Kern counties.

Clays of the montmorillonite and hallosite group ('rock soap') are being utilized by some of the oil refineries in lieu of true fuller's earth in the refining of petroleum products.

The production of 53,323 tons valued at $501,743 here credited to 1928 as 'fuller's earth' is in reality colloidal clay of the montmorillonite class (sold under such local names as 'bentonite,' 'otaylite,' 'shoshonite,' derived from the locality where found). Because of its being utilized for clarifying, filtering, and cleanser purposes, most of it in petroleum refining, we have placed it, for the purpose of the State Division of Mines statistical reports under the fuller's earth heading.

After all, the practical test of a fuller's earth is not so much chemical, as a physical one; that is, its physical capacity to absorb basic colors and to remove these colors from solution in animal, vegetable, or mineral oils, also from water.

The 1928 output above noted is a large increase in both amount and value from the 13,018 tons and $154,764 in 1927, and came from seven properties, in Inyo, Kern, San Bernardino, and San Diego counties.

Fuller's Earth Production of California, by Years.

Fuller's earth was first produced commercially in this state in 1899, and the total amount and value of the output since that time are as follows:

Year	Tons	Value	Year	Tons	Value
1899	620	$12,400	1915	692	$4,002
1900	500	3,750	1916	110	550
1901	1,000	19,500	1917	220	2,180
1902	987	19,246	1918	37	333
1903	250	4,750	1919	385	3,810
1904	500	9,500	1920	600	6,000
1905	1,344	38,000	1921	1,185	8,295
1906	440	10,500	1922	6,606	48,756
1907	100	1,000	1923	3,650	55,125
1908	50	1,000	1924	5,290	67,295
1909	459	7,385	1925	5,280	91,842
1910	340	3,820	1926	23,552	250,192
1911	466	5,294	1927	13,018	154,764
1912	876	6,500	1928	53,323	501,743
1913	460	3,700			
1914	760	5,928	Totals	123,100	$1,347,160

GEMS

Bibliography: State Mineralogist Reports II, XIV, XV, XVII, XVIII, XX, XXI. Bulletins 37, 67, 91. U. S. G. S., 'Mineral Resources of the U. S.'; Bull. 603, p. 208. Bull. Dept. Geol. Univ. of Cal., Vol. 5, pp. 149–153, 331–380. Am. Jour. Sci., Vol. 31, p. 31.

The production of gem materials in California has been somewhat irregular and uncertain since 1911. The compilation of complete statistics is difficult owing to the widely scattered places at which stones are gathered and marketed for the most part in a small way. The material reported in 1928 totaled $22,200 in value compared with $7,035 in 1927, the increase being due mainly to quartz crystals from Calaveras County.

The following table shows the distribution of rough, uncut gem and jeweler's materials during 1928.

County	*Value*	*Kind*
Butte	$400	Diamonds and sapphires.
San Diego	1,700	Tourmaline, kunzite, golden and pink beryl, blue tourmaline, spessartite, garnet and indicolite.
Calaveras	* 20,100	Quartz crystals.
Fresno		Blue, white and brown topaz.
Inyo		Agate.
San Bernardino		Agate and topaz.
Sonoma		Hyalite.
Siskiyou		Rhodonite.
Tulare		Chrysoprase.
Total value	$22,200	

* Combined to conceal the output of a single operator in each.

Varieties of California's Gem Stones.

Diamonds have been found in a number of localities in California; but in every case, they have been obtained in stream gravels while working them for gold. The principal districts have been: Volcano in Amador County; Placerville, Smith's Flat and others in El Dorado County; French Corral, Nevada County; Cherokee Flat, Morris Ravine, and Yankee Hill, Butte County; Gopher Hill and upper Spanish Creek, Plumas County. The most productive district of recent years has been Cherokee in Butte County.

California *tourmalines* are decidedly distinctive in coloring and 'fire' as compared to foreign stones of this classification. The colors range from deep ruby to pink, and various shades of green, also blue.

One of our California gem stones, *benitoite,* has not been found elsewhere; and in but a single locality here: The Dallas Mine in San Benito County.

Kunzite, a gem variety of spodumene, was first found in the Pala district in San Diego County. It has thus far been found in only one locality (Madagascar) outside of California. It is of a lilac color, and is described in detail in Bulletin 37 of the State Mining Bureau.

Beryls of excellent fire and delicate colors are also obtained in the Pala district, of which the *aquamarine* (blue) and *morganite* (pink) varieties deserve special mention. Morganite, like kunzite, has thus far been found elsewhere only in Madagascar.

Californite, or 'California jade,' is a gem variety of *vesuvianite,* and is green or white in color. It is found in Butte, Fresno, and Siskiyou counties.

Stones of precious blue *topaz* of fine quality are being cut from crystals mined in northern San Diego County. They are associated with beryl and blue tourmaline.

Some *rhodonite* has been mined in Siskiyou County, and used for decorative purposes, its value being included in the marble figures.

Garnets are found in a number of localities in California; the important yield of gems being *hyacinth* and *spessartite* varieties from San Diego County.

Chrysoprase has been produced in Tulare County.

Turquoise has been found in the desert section of San Bernardino County, but none produced commercially in recent years.

Sapphires have been reported found in San Bernardino and Riverside counties, but not as yet confirmed. A few have been found in stream gravels with diamonds in Butte County.

Rubies have been identified by the laboratory of the State Mining Bureau, occurring in limestone from the Baldy Mountains, San Bernardino County. Thus far no stones of commercial size have been taken out.

Total Production of Gem Materials in California.

The value of the gem output in California annually since the beginning of commercial production is as follows:

Year	Value	Year	Value
1900	$20,500	1915	$3,565
1901	40,000	1916	4,752
1902	162,100	1917	3,049
1903	110,500	1918	650
1904	136,000	1919	5,425
1905	148,500	1920	36,056
1906	497,090	1921	10,954
1907	232,642	1922	1,312
1908	208,950	1923	13,220
1909	193,700	1924	4,800
1910	237,475	1925	10,663
1911	51,824	1926	9,049
1912	23,050	1927	7,035
1913	13,740	1928	22,200
1914	3,970		
		Total	$2,212,771

GRAPHITE

Bibliography: State Mineralogist Reports XIII, XIV, XV, XVII. Bulletins 67, 91. U. S. G. S., Min. Res., 1914, Pt. II.

Graphite (also called plumbago) has been produced from time to time in the state, coming principally from Sonoma and Los Angeles counties. It is difficult for these deposits, which must be concentrated, to compete with foreign supplies, which go on the market almost directly as they come from the deposit. Graphite ores are concentrated with considerable difficulty, and the electric process of manufacturing artificial graphite from coal has been perfected to such a degree that only deposits of natural graphite of a superior quality can be exploited with any certainty of success.

According to the U. S. Geological Survey, operators in this country who are working disseminated flake deposits must depend on their No. 1 and No. 2 flake for their profit. Graphite dust is merely a by-product and is salable only at a low price.

The principal value of graphite is on account of its infusibility and resistance to the action of molten metals. It is also largely used in the manufacture of electrical appliances, of 'lead' pencils, as a lubricant, as stove polish, paints, and in many other ways. Amorphous graphite, commonly carrying many impurities, brings a much lower price. For some purposes, such as foundry facings, etc., the low-grade material is satisfactory. Among the interesting uses for graphite is the prevention of formation of scale in boilers. The action is a mechanical one. Being soft and slippery, the graphite prevents the particles of scale from adhering to one another or to the boiler and they are thus easily removed.

The price increases with the grade of material, the best quality crystalline variety being quoted at present (f. o. b. New York) at 8–9¢ per pound (Ceylon lumps).

The coarser flakes are necessary for crucibles, as they help to bind the clay together, in addition to their refractory service. Imports in 1928 from Ceylon, Canada, Madagascar, Mexico and Korea totaled 17,843 short tons, valued at $808,557 compared with 17,429 tons valued at $772,004 in 1927.

Occurrence of graphite has been reported at various times from Calaveras, Fresno, Imperial, Inyo, Los Angeles, Mendocino, San Bernardino, San Diego, Siskiyou, Sonoma and Tuolumne counties.

Graphite Production of California, by Years.

According to the records of the State Mining Bureau, the graphite production of California, by years, has been as follows:

Year	*Pounds*	*Value*
1901	128,000	$4,480
1902	84,000	1,680
1903		
1913	2,500	25
1914		
1915		
1916	29,190	2,335
1917		
1918	*770,000	37,225
1919		
1920		
1921	*624,000	26,160
1922		
1923		
1925		
1926	*76,000	13,120
1927		
1928		
Totals	2,113,690	$85,025

* Annual details concealed under 'Unapportioned,' on account of a single producer.

GYPSUM

Bibliography: State Mineralogist Reports XIV, XV, XVII, XVIII, XXII. Bulletins 38, 67, 91. U. S. Geol. Surv., Bull. 223, 413, 430, 697. U. S. Bur. of Standards, Circular No. 281.

During 1928 one operator each in Imperial and Kern counties and two in Riverside produced a total of 104,790 tons of gypsum, valued at $200,567, compared with 94,630 tons and $211,337 in 1927. The material was utilized mainly in cement manufacture as a retardant, for hard-wall plaster (including wall board), and for fertilizer.

Uses.

The most important use of gypsum from the quantity standpoint is in the calcined form where it is utilized in the manufacture of various hard-wall plasters and plaster board. As plaster of paris, it plays a very important part in surgical work. Approximately 2%, by weight, raw gypsum is added in the manufacture of Portland cement just before the final grinding. In this application, the gypsum acts as a retarder to the set of the cement. The use of gypsum tile for non-bearing fireproof partitions, stairway and elevator enclosures, and the protection of steel columns, girders and beams, has increased greatly.

Keene's cement is a gypsum product, calcined to complete dehydration, and an accelerator added such as alum, potassium sulphate, borax, aluminum sulphate.

Land plaster may be applied to the soil by drilling, or scattered in the hill, or it may be sowed broadcast, in quantities ranging from 200 to 500 pounds to the acre.

Gypsum plant of Pacific Portland Cement Co. at Plaster City, Imperial County, Cal. Photo by Walter W. Bradley.

Total Production of Gypsum in California.

Production of gypsum annually in California since such records have been compiled by this Bureau is as follows:

Year	Tons	Value	Year	Tons	Value
1887	2,700	$27,000	1909	30,700	$138,176
1888	2,500	25,000	1910	45,294	129,152
1889	3,000	30,000	1911	31,457	101,475
1890	3,000	30,000	1912	37,529	117,388
1891	2,000	20,000	1913	47,100	135,050
1892	2,000	20,000	1914	29,734	78,375
1893	1,620	14,280	1915	20,200	48,953
1894	2,446	24,584	1916	33,384	59,533
1895	5,158	51,014	1917	30,825	56,840
1896	1,310	12,580	1918	19,695	37,176
1897	2,200	19,250	1919	19,813	50,579
1898	3,100	23,600	1920	20,507	92,535
1899	3,663	14,950	1921	37,412	78,875
1900	2,522	10,088	1922	47,084	188,336
1901	3,875	38,750	1923	86,410	289,136
1902	10,200	53,500	1924	25,569	53,210
1903	6,914	46,411	1925	107,613	172,444
1904	8,350	56,592	1926	114,868	211,337
1905	12,859	54,500	1927	94,630	292,090
1906	21,000	69,000	1928	104,790	200,567
1907	8,900	57,700			
1908	34,600	155,400	Totals	1,128,522	$3,385,456

LIMESTONE

Bibliography: State Mineralogist Reports IV, XII–XV (inc.), XVII–XXIII (inc.). Bulletins 38, 91. Oregon Agr. College Extension Bulletin 305. Eng. and Min. Jour.-Press, Vol. 120, pp. 249–253.

'Industrial' limestone was produced in nine counties during 1928, to the amount of 127,895 tons, valued at $397,935, being a decrease both in quantity and value compared to the 1927 output of 699,790 tons, worth $663,957.

The amount here given does not include the limestone used in the manufacture of cement nor for macadam and concrete, nor of lime for building purposes; but accounts for that utilized as a smelter and foundry flux, for glass and sugar making, and other special chemical and manufacturing processes. It also includes that utilized for fertilizers (agricultural 'lime'), 'roofing gravel,' paint and concrete filler, whiting for paint, putty, kalsomine, terrazzo, paving dust, chicken grit, carbon dioxide gas, 'paving compound,' facing dust for concrete pipe, also for rubber and magnesite mix. That from Santa Clara and Los Angeles counties is calcareous marl sold for agricultural purposes. Of the total product in 1928, approximately 28,845 tons, valued at $106,180, were used for agricultural purposes.

Distribution of the 1928 output was as follows:

County	*Amount*	*Value*
El Dorado	57,012	$158,252
San Bernardino	11,201	40,224
Santa Cruz	8,600	24,849
Kern, Los Angeles, Riverside, San Mateo, Santa Clara, Tulare, Tuolumne *	51,082	174,610
Totals	127,895	$397,935

* Combined to conceal the output of a single operator in each.

Limestone Production of California, by Years.

The following tabulation gives the amounts and value of 'industrial' limestone produced in California by years since 1894 when compilation of such records was begun by the State Mining Bureau. These tonnages consist principally of limestone utilized for flux, glass and sugar making, agricultural, chemical, and other special industrial purposes. That utilized in cement manufacture is not included:

Year	Tons	Value	Year	Tons	Value
1894	15,420	$19,275	1912	613,375	$570,248
1895	71,355	71,690	1913	301,918	274,455
1896	68,184	71,112	1914	572,272	517,713
1897	36,796	38,556	1915	146,324	156,288
1898	27,686	24,548	1916	187,521	217,733
1899	30,769	29,185	1917	237,279	356,396
1900	32,791	31,532	1918	208,566	456,258
1901	76,937	99,445	1919	88,291	248,145
1902	71,422	90,524	1920	90,120	298,197
1903	125,919	163,988	1921	75,921	305,912
1904	40,207	87,207	1922	84,382	282,181
1905	192,749	323,325	1923	143,266	348,464
1906	80,262	162,827	1924	219,476	582,660
1907	230,985	406,041	1925	319,977	494,525
1908	273,890	297,264	1926	108,795	367,501
1909	337,676	419,921	1927	699 790	663,957
1910	684,635	581,208	1928	127,895	397,935
1911	516,398	452,790			
			Totals	7,139,249	$9,909,006

LITHIA

Bibliography: State Mineralogist Reports II, IV, XIV, XXI, Bulletins 38, 67, 91.

Lithia mica, lepidolite (a silicate of lithium et al.) utilized in the manufacture of artificial mineral water, fireworks, glass, etc., has been mined in San Diego County since 1899, except between 1905 and 1915, though there was none shipped in 1923 and 1925. The 1928 figures are concealed under the 'Unapportioned' item. Some amblygonite, a lithium phosphate, is occasionally also obtained from pockets associated with the gem tourmalines.

Lithia mica total production in the state has been as follows:

Year	Tons	Value	Year	Tons	Value
1899	124	$4,600	1919	800	$14,400
1900	440	11,000	1920	10,046	153,502
1901	1,100	27,500	1921	*1,365	20,781
1902	822	31,880	1922		
1903	700	27,300	1923		
1904	641	25,000	1924	109	2,269
1905	25	276	1925		
1906			1926		
1915	91	1,365	1927	*540	13,500
1916	71	1,065	1928	*	*
1917	880	8,800			
1918	4,111	73,998	Totals	21,865	$417,236

*Annual details concealed under 'Unapportioned.'

MICA

Bibliography: State Mineralogist Reports II, IV. . Bulletins 38, 67, 91. U. S. Geol. Surv., Bull. 740; Min. Res. of U. S. Eng. & Min. Jour.-Press, Vol. 115, pp. 55–60, Jan. 13, 1923.

No commercial production of mica has recently been reported in California. Production in previous years has been as follows:

Year	*Tons*	*Value*
1902	50	$2,500
1903	50	3,800
1904	50	3,000
Totals	150	$9,300

Classification and Uses.

Practically all marketable mica is of the muscovite or phlogopite varieties. There are three main commercial classes: Sheet mica, including punch; splittings, and scrap. Sheet mica is used chiefly for electrical purposes and for glazing; splittings are made into built-up mica; scrap is ground to a powder. Mica to be classified as sheet must yield a rectangle of at least 1½ x 2 in., must split evenly and freely, be free from cracks, rulings, or plications, and reasonably free from inclusions of foreign matter, though stains of a nonconducting character are permissible for some uses. Ability to withstand heat and high electrical resistance have led to a wide application of sheet mica in the electrical industries. The electrical uses of sheet mica greatly exceed all others in quantity and value of the material used.

As a heat-resisting transparent medium, sheet mica has various uses. It is widely employed for stove windows, though this use has declined

to a considerable extent. A hard and rigid mica that is nearly clear is best suited for stove fronts. High-grade stove mica commands a higher price than electrical mica, because for the most part larger sizes are demanded. Mica is also used in furnace and bake-oven sight-holes, heat screens, lamp chimneys, canopies and shades, particularly for gas mantles, and also for military lanterns and in lantern slides.

Its ability to withstand shocks and strains, combined with its transparency, has led to wide use in motor goggles, spectacles, divers' helmets, smoke helmets, compass cards, gage fronts, and in windows subject to shock, as in the conning towers of warships. On account of its heat-resisting qualities, ground mica is used in railroad car axle packings, in pipe and boiler coverings, in fireproof paints, and in rubber tires. Ground mica is used as a component in roofing, as a filler in rubber and other products, in calico printing, and as a tire powder. It is used also in tinsel decorations, and as 'Santa Claus snow' for Christmas tree and window decorations. It is used as a lubricant for wooden bearings, and mixed with oil for metal bearings.

MINERAL PAINT

Bibliography: State Mineralogist Reports XII–XIX (inc.), XXI, XXII. Bulletins 38, 91.

Mineral paint material was produced in California in 1928 by a single operator each in Placer and Stanislaus counties. This material was a yellow ocher. There was a slight increase in both quantity and value from the 1927 production.

There has been a steady production of mineral paint in California since 1890, when the first recorded production was made. This material came from Alameda, Amador, Butte, Calaveras, Colusa, Los Angeles, Napa, Nevada, Placer, Riverside, Shasta, Sonoma, Stanislaus, and Ventura counties. There are also other deposits that may have been of possible commercial value, but as yet there have been no commercial shipments from El Dorado, Imperial, Kern, Kings, Lake, Mendocino, San Diego, Siskiyou, Trinity, and Yuba counties, in which they are found.

California mineral paints have been used as the color pigments in mortar, stucco and cement mixes in kalsomine, pigments in oil paint, various fillers, in linoleum, in cosmetics, etc. Their colors vary greatly, as also their composition; yellow, the most common, is colored by limonite; red is colored from hematite; the browns might be colored with either or both hematite or limonite, all of which are mixed with more or less clay. There are several plants in the state that treat their ochers, and blend them to give uniform colors and quality at all times. The color of the materials as they come from the mine will vary, but when properly handled a uniform quality and color can be maintained.

These deposits are found either as soft fine-grained red shales, as gossan after sulphide ore bodies, as yellow or brown clays colored by water carrying iron in solution and depositing it on the clay or from spring waters high in iron which deposit an iron oxide or hydroxide.

Besides the natural deposits, tailings from chlorination plants, pyrite sinter from acid works and magnetite concentrated from black sands have been used in the manufacture of synthetic ochers.

Mineral Paint Production of California, by Years.

The first recorded production of mineral paint materials in the state was in the year 1890. The output, showing annual amount and value since that time, is given herewith:

Year	Tons	Value	Year	Tons	Value
1890	40	$480	1910	200	$2,040
1891	22	880	1911	186	1,184
1892	25	750	1912	300	1,800
1893	590	26,795	1913	303	1,780
1894	610	14,140	1914	132	847
1895	750	8,425	1915	311	1,756
1896	395	5,540	1916	643	3,960
1897	578	8,165	1917	520	2,700
1898	653	9,698	1918	728	4,738
1899	1,704	20,294	1919	1,780	17,055
1900	529	3,993	1920	779	8,477
1901	325	875	1921	446	4,748
1902	589	1,533	1922	1,620	13,277
1903	2,370	3,720	1923	1,049	11,773
1904	270	1,985	1924	532	5,234
1905	754	4,025	1925	669	6,969
1906	250	1,720	1926	569	5,846
1907	250	1,720	1927*	919	9,592
1908	335	2,250	1928*		
1909	305	2,325	Totals	22,430	$216,278

* Under 'Unapportioned.'

MINERAL WATER

Bibliography: State Mineralogist Reports VI, XII–XVIII (inc.), XXI–XXIII (inc.). U. S. G. S., Water Supply Paper 338. Min. Res. 1914, 1916. 'Mineral Springs and Health Resorts of California,' by Dr. Winslow Anderson, 1890. U. S. Dept. of Agr., Bur. of Chem., Bulletin 91.

A widespread production of mineral water is shown annually in California. These figures refer to mineral water actually bottled for sale, or for local consumption. Water from some of the springs having a special medicinal value brings a price many times higher than the average shown, while in some cases the water is used merely for drinking purposes and sells for a nominal figure. Health and pleasure resorts are located at many of the springs. The waters of some of the hot springs are not suitable for drinking, but are very efficacious for bathing.

From a therapeutic standpoint, California is particularly rich in mineral springs. The counterparts of many of the world-famed spas of Europe and the eastern United States can be found here. Radioactivity has been noted in at least three localities in California: At The Geysers in Sonoma County, Arrowhead Hot Springs in San Bernardino County, and Paraiso Springs, Monterey County. It doubtless exists at others, but the State Division of Mines and Mining has not as yet had funds available to conduct the necessary investigations along this line.

So far as the efficacy of radioactivity in mineral water is concerned, it has been found by investigations of the U. S. Geological Survey and the U. S. Department of Agriculture that it is not retained and transported in bottled water. Radioactivity in water is only tempo-

rary, and dissipates. To obtain whatever therapeutic effect it may possess, radioactive water should be utilized directly at the spring.

Commercial production of mineral water in California for 1928 amounted to a total of 25,049,002 gallons, valued at $1,304,969, being an increase in quantity and a decrease in value over the previous year, when 16,644,423 gallons, worth $1,487,183, were sold. The large decrease in value in 1928 is accounted for by some producers previously giving the value at point of distribution, rather than at rail shipping point.

Arrowhead Hot Springs, San Bernardino County, Cal. Bathhouse installation at steam caves. Photo by Walter W. Bradley.

The 1928 output was distributed by counties, as follows:

County	*Gallons*	*Value*
Butte	2,190	$1,045
Lake	123,500	22,750
Los Angeles	10,929,535	538,100
Napa	70,291	32,707
San Diego	71,845	3,592
Sonoma	32,720	9,126
Calaveras, Contra Costa, Fresno, Marin, Placer, Riverside, San Benito, San Bernardino, San Luis Obispo, Santa Barbara, Santa Clara, Siskiyou, Solano, Sonoma *	13,818,921	697,649
Totals	25,049,002	$1,304,969

* Combined to conceal output of a single operator in each.

The production above tabulated was in part bottled with artificial carbonation, in part natural and a large part was used in the preparation of soft drinks with flavors.

Although some of the operators complain that prohibition has all but killed off the mineral water business, the reports of actual production of mineral water bottled and sold indicate an encouraging growth and a material increase annually both in total quantity and value, as may be noted from the tabulation below, with the exception of 1928, which shows a decreased value, although an increased quantity.

Mineral Water Production of California, by Years.

Mineral water was bottled for sale, at the Napa Soda Springs, Napa County, as early as 1860, and at other springs in California, notably The Geysers, Sonoma County, also at early dates; but there are no figures available earlier than the year 1887. Amounts and values, annually, since that year are shown herewith:

Year	Gallons	Value	Year	Gallons	Value
1887	618,162	$144,368	1909	2,449,834	$465,488
1888	1,112,202	252,990	1910	2,335,259	522,009
1889	808,625	252,241	1911	2,637,669	590,654
1890	258,722	89,786	1912	2,497,794	529,384
1891	334,553	139,959	1913	2,350,792	599,748
1892	331,875	162,019	1914	2,443,572	476,169
1893	383,179	90,667	1915	2,274,267	467,738
1894	402,275	184,481	1916	2,273,817	410,112
1895	701,397	291,500	1917	1,942,020	340,566
1896	808,843	337,434	1918	1,808,791	375,650
1897	1,508,192	345,863	1919	2,233,842	340,117
1898	1,429,809	213,817	1920	2,391,791	421,643
1899	1,338,537	406,691	1921	3,446,278	367,476
1900	2,456,115	268,607	1922	4,276,346	486,424
1901	1,555,328	559,057	1923	5,487,276	616,919
1902	1,701,142	612,477	1924	8,159,211	818,726
1903	2,056,340	558,201	1925	12,115,072	1,230,455
1904	2,430,320	496,946	1926	14,074,877	1,171,550
1905	2,194,150	538,700	1927	16,644,423	1,487,183
1906	1,585,690	478,186	1928	25,049,002	1,304,969
1907	2,924,269	544,016			
1908	2,789,715	560,507	Totals	146,621,373	$20,651,492

PHOSPHATES

Bibliography: State Mineralogist Report XXI. Bulletins 67, 91.

No commercial production of phosphates has been recorded from California, though occasional pockets of the lithium phosphate, amblygonite, Li (AlF) PO_4, have been found associated with the gem tourmaline deposits in San Diego County. Such production has been classified under lithia.

PUMICE and VOLCANIC ASH

Bibliography: State Mineralogist Reports XII, XIV, XV, XVII, XVIII, XXII. Bulletin 38 (See 'Tufa').

The production of pumice and volcanic ash for the year 1928 amounted to 10,440 tons valued at $105,055, and came from properties in Fresno, Imperial, Inyo, Kern, Mono, and Tuolumne counties. In 1928 an increase both in tonnage and value compared with the 1927 shipments, which were 13,779 tons, worth $168,896, because the 1927 figures include also production over the past four years from a deposit for which reports had not been previously received.

The material from Imperial County and part of that from Mono is of the vesicular, block variety and was sold for abrasive purposes; the

balance of the Mono material and that from Fresno, Inyo, Kern and San Luis Obispo was the volcanic ash, or tuff variety, and was employed in making soap, cleanser compounds, and a large tonnage is being utilized as a concrete filler in cement displacement. The Kern County ash is going into the preparation of one of the popular and nationally advertised brands of cleanser compounds.

Pumice Production of California, by Years.

Commercial production of pumice in California was first reported to the State Mining Bureau in 1909, then not again until 1912, since which year there has been a small annual output, as indicated by the following table:

Year	Tons	Value	Year	Tons	Value
1909	50	$500	1920	1,537	$25,890
1910	----------	----------	1921	406	6,310
1911	----------	----------	1922	613	4,248
1912	100	2,500	1923	2,936	16,309
1913	3,590	4,500	1924	4,919	33,404
1914	50	1,000	1925	5,319	32,937
1915	380	6,400	1926	7,170	48,350
1916	1,246	18,092	1927	13,779	168,896
1917	525	5,295	1928	10,440	105,055
1918	2,114	28,669			
1919	2,388	43,657	Totals	57,562	$552,012

PYRITES

Bibliography: State Mineralogist Reports XVIII, XIX, XXII. Bulletins 38, 91. Min. and Sci. Press, Vol. 114, pp. 825, 840.

A total production of 90,566 tons of pyrite valued at $400,627 was reported shipped in California during 1928, from properties in Alameda, San Benito and Shasta counties. This was a decrease both in quantity and value from 1927 figures of 130,910 tons and $564,823. The material from San Benito County was an iron sulphate (not an iron sulphide), but was used in the manufacture of fertilizer and insecticide, the same as some of the pyrite, and therefore classed with pyrite.

The material was mostly used in the manufacture of sulphuric acid for explosives and fertilizers, but a portion was utilized directly in the preparation of agricultural fertilizer and insecticide. The sulphur content ranged up to 46.5% S.

This does not include the large quantities of pyrite, chalcopyrite, and other sulphides which are otherwise treated for their valuable metal contents. Some sulphuric acid is annually made as a by-product in the course of roasting certain tonnages of Mother Lode auriferous concentrates while under treatment for their precious metal values.

Pyrites Production in California, by Years.

The total recorded pyrites production in California to date is as follows:

Year	Tons	Value	Year	Tons	Value
1898	6,000	$30,000	1914	79,267	$230,058
1899	5,400	28,620	1915	92,462	293,148
1900	3,612	21,133	1916	120,525	372,969
1901	4,578	18,429	1917	111,325	323,704
1902	17,525	60,306	1918	128,329	425,012
1903	24,311	94,000	1919	147,024	540,300
1904	15,043	62,992	1920	146,001	530,581
1905	15,503	63,958	1921	110,025	473,735
1906	46,689	145,895	1922	151,381	570,425
1907	82,270	251,774	1923	148,004	555,308
1908	107,081	610,335	1924	124,214	517,835
1909	457,867	1,389,802	1925	129,500	528,550
1910	42,621	179,862	1926	100,896	466,088
1911	54,225	182,954	1927	130,910	564,823
1912	69,872	203,470	1928	90,566	400,627
1913	79,000	218,537	Totals	2,841,056	$10,355,280

SHALE OIL

Bibliography: State Mineralogist Report XIX. U. S. Geol. Surv., Bulletins 322, 729. U. S. Bur. of Mines, Bull. 210. Eng. and Min. Jour.-Press, Vol. 118, No. 8, pp. 290–292, Aug. 23, 1924. Chem. & Met. Eng., Vol. 32, No. 6, Feb., 1925. Min. Congress Jour., Dec., 1924.

Oil Shale is defined by Gavin,[1] as follows:

"Oil shale is a compact, laminated rock of sedimentary origin, yielding over 33 per cent of ash and containing organic matter that yields oil when distilled, but not appreciably when extracted with the ordinary solvents for petroleum.

* * * * * * *

"Oil shales contain a substance, or substances, usually classed as a pyro-bitumen, that by destructive distillation, or pyrolysis, yields oils somewhat similar to petroleum. These substances have been termed 'kerogen,' from two Greek words meaning producer of wax."

The Scottish oil shales are also known as 'torbanite.'

The so-called 'oil shales' of California do not for the most part conform to the above definition, as the greater part of the oil obtained from them occurs as such and can be extracted by suitable solvents. The most extensive deposits in this state are part of the Monterey formation of Tertiary age, and physically and chemically are different from the oil shales of Scotland and from other oil shales in the United States. The mineral matter of this shale is diatomaceous; the beds that yield oil occur in massive formation; and when freshly broken smell strongly of petroleum. Most geologists consider the Monterey shales to have been the origin of the oil in some of the oil fields of California.

Although the extraction of shale oil has been a matter of commercial practice on a considerable scale for many years in Scotland, France, and Australia, it has not attained any great commercial importance as yet in the United States. Technical knowledge of the subject, however, is increasing. With the gradual depletion of the underground

[1] Gavin, M. J., Oil Shale, An Historical, Technical, and Economic Study: U. S. Bur. of Mines, Bull. 210, p. 26, 1924.

reserves of liquid oil, it is merely a matter of time until the development of the oil shales of the United States will be an economic necessity. The selling price of petroleum will be the determining factor. The recovery of by-product ammonium sulphate is an important feature of the process.

Two plants on a more or less experimental scale have been in operation in California for several years past, with commercial production beginning in a small way in 1922. The product, in part, has been sold for utilization as a flotation oil in metallurgical work, and part has been consumed as fuel at the plants. There was no production reported for 1928. As only one plant reported output for 1927, the value is concealed under the 'unapportioned' item.

Shale Oil Production of California, by Years

Year	*Barrels*	*Value*
1922 } 1923 }*	4,333	$44,262
1924 } 1925 }*	8,688	55,240
1926 } 1927 }*	8,819	9,998
1928	----	----
Totals	21,840	$109,500

* Annual details concealed under 'Unapportioned.'

SILICA (Sand and Quartz)

Bibliography: State Mineralogist Reports IX, XIV, XV, XVII, XVIII, XX–XXIII. Bulletins 38, 67, 91.

We combine these materials because of the overlapping roles of vein quartz which is mined for use in glass making and as an abrasive, and that of silica sand which, although mainly utilized in glass manufacture, also serves as an abrasive. Both varieties are also utilized to some extent in fire-brick manufacture.

A portion of the tonnage of vein quartz in California in 1916 and 1917 was employed in the preparation of ferro-silicon by the electric furnace. At present, some is utilized as a foundry flux, and for steel-casting molds. A portion of the silica sold (both sand and quartz) is also used in glazes for porcelain, pottery and tile, and in the body of the ware to diminish shrinkage; and some of the sand for the preparation of sodium silicate ('water glass'). Manufacturers of paint use finely-ground silica, which forms as much as one-third of the total pigment in some paints. For certain purposes finely-ground crystalline material is superior in paints to other materials because of the angularity of the grains, which makes them adhere more firmly to the article painted and after wear afford a good surface for repainting. The same angularity makes artificially comminuted crystalline quartz superior to natural sand for use in wood fillers. It is also preferable for soaps and polishing powders. Part of the 1925 output was used for roofing and stucco-dash granules.

We do not include under this heading such forms of silica as: quartzite, sandstone, flint, tripoli, diatomaceous earth, nor the gem forms of 'rock crystal,' amethyst, and opal. Each of these has various industrial uses, which are treated under their own designations.

The production of silica in California in 1928 amounted to 14,814 tons, valued at $66,679, from nine properties in five counties, El Dorado, Imperial, Mariposa, Riverside and San Diego. This was a decrease from 24,636 tons valued at $94,762 in 1927. Of the above total 7542 tons was of sand and 7272 tons of vein and boulder quartz. For making the higher grades of glass, most of the sand is imported from Belgium. Belgium sand has also displaced local material in the manufacture of sodium silicate ('water-glass'). There are various deposits of quartz in California which could be utilized for glass making, but to date they have not been so used owing to the cost of grinding and the difficulty of preventing contamination by iron while grinding.

Silica sand has been produced in the following counties of the state: Alameda, Amador, El Dorado, Los Angeles, Mono, Monterey, Orange, Placer, Riverside, San Diego, San Joaquin, and Tulare, the chief centers being Amador, Monterey and Los Angeles counties. The industry is of limited importance, so far, because of the fact that much of the available material is not of a grade which will produce first-class colorless glass; for such, it must be essentially iron-free. Even a fractional per cent of iron imparts a green color to the glass.

Total Silica Production of California.

Total silica production in California since the inception of the industry, in 1899, is shown below, being mainly sand:

Year	Tons	Value	Year	Tons	Value
1899	3,000	$3,500	1915	28,904	$34,322
1900	2,200	2,200	1916	20,880	48,908
1901	5,000	16,250	1917	19,376	41,166
1902	4,500	12,225	1918	23,257	88,930
1903	7,725	7,525	1919	18,659	101,600
1904	10,004	12,276	1920	25,324	96,793
1905	9,257	8,121	1921	10,569	49,179
1906	9,750	13,375	1922	9,874	31,016
1907	11,065	8,178	1923	7,964	30,420
1908	9,255	22,045	1924	6,808	35,006
1909	12,259	25,517	1925	12,498	96,780
1910	19,224	18,265	1926	30,010	104,317
1911	8,620	8,672	1927	24,636	94,762
1912	13,075	15,404	1928	14,814	66,679
1913	18,618	21,899			
1914	28,538	22,688	Totals	425,663	$1,138,018

SILLIMANITE—ANDALUSITE—CYANITE GROUP

Bibliography: State Mineralogist Report XX. Bulletins 67, 91. Dana's Mineralogy. U. S. Geol. Surv., Prof. Paper 110. Eng. & Min. Jour.-Press, Vol. 120, pp. 91–94, 1925. Amer. Mineralogist, June, 1924.

Sillimanite and andalusite are both aluminum silicates (Al_2SiO_5), having the same composition and formula, but with slightly different physical characteristics. Though both crystallize in the orthorhombic system, their crystal habits are different, andalusite being usually in coarse prismatic forms, the prisms nearly square in shape; also occurs massive, imperfectly columnar, and sometimes radiated and granular. Sillimanite commonly occurs in long, slender crystals, not distinctly terminated; prismatic faces striated and rounded; often in close parallel groups, passing into fibrous and columnar massive forms,

sometimes radiating. Colors are similar. Hardness, andalusite 7.5, sillimanite 6–7. Andalusite is slightly lighter in specific gravity.

A massive deposit of andalusite, found in Dry Creek Canyon in the White Mountains of the Inyo Range, in Mono County, is being mined by the Champion Porcelain Company of Detroit, Michigan, but no shipments were made in 1928 while roads were being constructed to the mine. The material is shipped East and utilized in the manufacture of porcelain for automobile spark plugs, for other high-tension electric insulators, laboratory ware and porcelain. Porcelain made from these minerals can be subjected to sudden and extreme changes in temperature without damage.

Cyanite is also an aluminum silicate (Al_2SiO_5), of the same chemical composition as andalusite and sillimanite, but crystallizing in the triclinic system. Occurs usually in long-bladed crystals, rarely terminated; hardness 5-7.25; gravity 3.56-3.67 (being heavier than the other two); color, blue. A deposit of cyanite, apparently in quantity, is being developed in Imperial County, near Ogilby, and shipments made to a refractory plant in Los Angeles.

Dumortierite, though differing somewhat in composition from the above, being a basic aluminum silicate ($4\ Al_2O_3.3\ SiO_2$), has proved similar in behavior in ceramic work so that it is now being mixed with andalusite for electrical procelains. A deposit of this mineral in Nevada is being mined for that purpose. Occurrences of massive dumortierite are known in Imperial County in this state and there may yet be some commercial possibilities for them.

Total Sillimanite Group Production of California, by Years.

Year	*Tons*	*Value*
1922 1923 1924 *	4,584	$98,790
1925 1926 *	4,810	203,000
1927 1928 *	4,276	76,000
Totals	13,670	$377,790

* Annual details concealed under 'Unapportioned.'

SOAPSTONE and TALC

Bibliography: State Mineralogist Reports XII, XIV, XV, XVII–XXIII. Bulletins 38, 67, 91. U. S. Bur. of Mines, Bulletin 213. Rep. of Investigations, Serial No. 2253, May, 1921.

The total output of talc and soapstone in California in 1928 amounted to 18,668 tons valued at $251,372, an increase over the 1927 output, which was 16,218 tons and $164,744. Over 80 per cent of the product was high-grade talc from Inyo and San Bernardino counties, which material was utilized mainly in toilet powders, paint, paper and rubber manufacture, and some in ceramics. The remainder came from Butte, Calaveras and El Dorado counties, being soapstone, with some of the El Dorado material, a steatite variety, used in making electrical insulators. El Dorado and Inyo have three producers each, Butte two producers, Calaveras and San Bernardino a single producer each.

The 'soapstone' grades were used mainly for roofing granules and as a filler in roofing paper, and part also in magnesite cement.

It is reported that California talc is steadily replacing imported talc in the toilet trade on the basis of quality. The largest production of

talc in the United States comes from Vermont and New York, and of massive soapstone from Virginia.

Composition and Varieties.

Talc is hydrous magnesium silicate with the chemical formula $H_2Mg_3(SiO_3)_4$. It is also called soapstone and steatite. The term 'talc' properly includes all forms of the pure mineral, whereas 'steatite' denotes particularly the massive, compact variety, and 'soapstone' the impure, massive forms containing as low as 50% of talc. When pure, talc is soft, having a hardness of 1, but impurities increase the hardness up to 3 or 4. The color varies from pure white and silvery white through gray, green, apple green, to dark green, also yellow, brown, and reddish when impure. It is commonly compact or massive, or in fine granular aggregates, and often in foliated plates or in fibrous aggregates.

Uses.

Although the uses of talc and soapstone are many and varied, some of them are not in general well known nor fully developed; and although few of their uses can justly be considered essential in the sense that no substitute can be used, there are several which are of great importance. The widest use of talc is in the powdered form, and the value depends upon color (whiteness), uniformity, fineness of grain, freedom from grit, 'slip,' and sometimes freedom from lime. The white varieties, free from grit and iron, low in lime, ground to 200-mesh and finer, are largely used as a filler for paper, rubber and paint, and the very highest grade as toilet powder. Ground talc is also used in dressing and coating cloth, in making soap, rope, twine, pipe-covering compounds, heavy lubricants, and polishes, and as a filler in concrete to make it waterproof. Ground talc and soapstone are used for foundry facings, either alone or mixed with graphite and a coarser grade is used in the manufacture of asphalt-coated roofing felts and papers, both as a filler and as a surfacing. Massive close-grained talc, free from iron and grit, is cut into blanks and baked, forming the material used for gas tips and electrical insulation, commonly known as 'lava.' Its hardness, its resistance to heat, acids and alkalies, and its great dielectric strength make it very useful for electric insulation, and no satisfactory substitute for it has been found.

Massive varieties of talc, pyrophyllite, and high grades of soapstone are cut into slate pencils and steel-workers' crayons. 'French chalk' or 'tailor's chalk' is a soft, massive talc. In China, Japan and India, massive talc (steatite) is carved into grotesque images and other forms, and is often sold as imitation jade. Soapstone is cut into slabs of 1 and 2 inches in thickness and sold as griddles, footwarmers, and fireless-cooker stones, or fabricated into laundry sinks and tubs, laboratory-table tops, hoods, tanks and sinks, electric switchboards, and for other uses in which the properties of resistance to heat, acids and alkalies, and electricity are essential.

Imports.

Foreign importations of high-grade white talc suitable for the manufacture of toilet powder have come mainly from Canada, Italy and

France. Foreign producers have the benefit of cheap labor, and a low tariff import duty. In addition to these disadvantages, California operators have to contend with transcontinental freight rates to the eastern manufacturing centers. In 1928 importations totaled 27,007 short tons, valued at $576,454, compared with 25,123 tons, valued at $545,285 in 1927, according to the United States Bureau of Foreign and Domestic Commerce.

Talc Production of California, by Years.

Production was intermittent in the state up to 1912; but there has been a material growth since 1916, as shown in the following table:

Year	Tons	Value	Year	Tons	Value
1893	400	$17,750	1912	1,750	$7,350
1894			1913	1,350	6,150
1895	25	375	1914	1,000	4,500
1896			1915	1,663	14,750
1897			1916	1,703	9,831
1898			1917	5,267	45,279
1899			1918	11,760	85,534
1900			1919	8,764	115,091
1901	10	119	1920	11,327	221,362
1902	14	288	1921	8,752	130,078
1903	219	10,124	1922	13,378	197,186
1904	228	2,315	1923	17,439	252,661
1905	300	3,000	1924	16,179	242,770
1906			1925	15,465	239,084
1907			1926	17,004	255,645
1908	3	48	1927	16,218	164,744
1909	33	280	1928	18,668	251,372
1910	740	7,260			
1911			Totals	169,659	$2,284,946

STRONTIUM

Bibliography: Bulletins 67, 91. U. S. G. S., Bull. 540; 660–I.

There has been no production of strontium minerals in California since 1918, though in that year both celestite ($SrSO_4$), and the carbonate, strontianite ($SrCO_3$) were shipped. The first recorded commercial output of strontium minerals in California was in 1916. The occurrence of the carbonate is particularly interesting and valuable, as it appears to be the only considerable deposit of commercial importance so far opened up in the United States. Shipments reported as averaging 80% $SrCO_3$ have been made. The deposit is associated with deposits of barite, near Barstow, San Bernardino County. The carbonate has also been found in massive form near Shoshone, Inyo County. In addition to Imperial County, celestite is found near Calico and Ludlow, and in the Avawatz Mountains in San Bernardino County, but as yet undeveloped.

Production of strontium minerals in California, by years, has been as follows:

Year	Tons	Value
1916	57	$2,850
1917	3,050	37,000
1918	2,900	33,000
1919		
Totals	6,007	$72,850

The principal use for strontium in the United States is in the form of the nitrate in the manufacture of red flares, or Costen and Bengal lights and fireworks. It is imported mainly from Germany and England. In Germany and Russia, strontium in the form of the hydroxide is used in the manufacture of beet sugar. It is stated that strontia is more efficient and satisfactory in that process than lime, as it gives an additional recovery of 6% to 8%.

Of the two minerals, strontianite (carbonate) and celestite (sulphate), the carbonate is the more desirable, as it is easier to convert to other salts; but it is scarcer. Celestite is found with limestone and sandstone and is sometimes associated with gypsum. Strontianite is also found with limestone, but associated with barite and calcite.

SULPHUR

Bibliography: State Mineralogist Reports IV, XIII, XIV. Bulletins 38, 67, 91.

In 1923–1924 there was a small production of sulphur, from a single property in Kern County. It was ground, and utilized as a fertilizer and in dusting for mildew. This was the first commercial output of native surphur in California for many years, although this mineral has been found to some extent in Colusa, Imperial, Inyo, Kern, Lake, Sonoma, Tehama, and Ventura counties.

Sulphur was produced at the famous Sulphur Bank mine in Lake County, during the years 1865–1868 (inc.), totaling 941 tons, valued at $53,500; following which the property became more valuable for its quicksilver. The Elgin quicksilver mine, near Wilbur Springs, Colusa County, is a similar occurrence.

The principal sources in the United States are the stratified deposits in Louisiana and Texas, extraction being accomplished by a unique system of wells with steam pipes. It is stated that three large companies operating there are capable of producing more than 1,000,000 tons annually in excess of our normal consumption in the United States, which averages about 600,000 tons. The mines at Freeport, Texas, are in a peculiarly favorable location in that they are practically at tidewater.

Formerly considerable sulphur was imported from Italy and from Japan; but the situation is now reversed, so that in 1928 a total of 685,260 long tons, valued at $14,351,731, was exported from the United States, principally to Europe and Canada, also Australia, New Zealand, Mexico and South America.

CHAPTER SIX

SALINES

Bibliography: State Mineralogist Reports III, XIV, XV, XVII–XXIII (inc.). Bulletin 24. Spurr and Wormser, "Marketing of Minerals." "Non-Metallic Minerals," by R. B. Ladoo. See also under each substance.

Under this heading are included borax, common salt, soda, potash, and other alkaline salts. The first two have been produced in a number of localities in California, more or less regularly since the early sixties. Except for a single year's absence, soda has had a continuous production since 1894. Potash, magnesium chloride and sulphate, and calcium chloride have been added to the commercial list in recent years, and in 1926 joined by bromine. The nitrates are still prospective.

Our main resources of salines are the lake beds of the desert regions of Imperial, Inyo, Kern, Los Angeles, San Bernardino, and San Luis Obispo counties, and the waters of the Pacific Ocean.

The total value of this group shows an increase to $8,744,057 in 1928 over the 1927 figures of $7,350,892 as detailed in the following tabulation:

Substance	1927		1928		Increase+ Decrease— Value
	Tons	Value	Tons	Value	
Borates	72,462	$3,043,260	109,722	$3,378,552	$335,292+
Potash	67,340	1,952,852	*	*	*
Salt	263,028	639,127	340,480	1,024,656	385,529+
Soda	62,571	1,478,237	80,838	1,469,297	8,940—
Unapportioned		[1]237,416		[2]2,871,552	2,634,136+
Total value		$7,350,892		$8,744,057	
Net increase					$1,393,165

* Under "Unapportioned."
[1] Includes bromine, calcium chloride and magnesium salts.
[2] Includes bromine, calcium chloride, magnesium salts and potash.

BORATES

Bibliography: State Mineralogist Reports III, X, XII–XV (inc.), XVII–XXIII (inc.). Bulletins 24, 67, 91.

During 1928 there was produced in California a total of 123,761 tons of borate materials, compared with 89,093 tons for the year 1927. The material shipped during the year included crude and select colemanite ore from Inyo County, the new sodium borates, kernite (Rasorite), kramerite and some colemanite from Kern County; also crystallized borax prepared by evaporation of brines at Searles Lake in San Bernardino County.

As the crude ore is not sold as such, but is almost entirely calcined before shipping to the refinery for conversion into the borax of commerce, and because of the fact that the material varied widely in boric

acid content, we have recalculated the tonnage to a basis of 40%, A.B.A. This is approximately the average A.B.A. content of the colemanite material after calcining, and also of the crystallized borax obtained from evaporation of the lake brines.

Recalculated as above, the 1928 production totals 109,722 tons, valued at $3,378,552, an increase over the similar figures for 1927, which were 72,462 tons and $3,043,260.

Colemanite is a calcium borate, and the material mined is shipped to seaboard chemical plants for refining. The latest development in the borax industry is the finding in quantity and opening up of a new borate mineral which bids fair to supplant colemanite in much the same way that colemanite deposits displaced the borax industry in the desert playas or dry lakes, some forty years ago. This new mineral is 'kernite' (or 'rasorite'), a sodium borate with a smaller water-of-crystallization content than the 'borax' of commerce, so that when re-crystallized to borax, the resulting product has an increased weight over the original material. These deposits are being opened up by the Pacific Coast Borax Company in southeastern Kern County.

Refined 'borax' (sodium tetraborate) is used in making the enameled coating for cast-iron and steelware employed in plumbing fixtures, chemical equipment, and kitchen utensils. It is also a constituent of borosilicate glasses which are utilized in making lamp chimneys, baking dishes, and laboratory glassware. Other important uses of borax are in the manufacture of laundry and kitchen soaps, in starch, paper sizing, tanning, welding, and in the preparation of boric acid, which is employed as an antiseptic and in preserving meats. Among the newer uses for borax is its employment in the preserving of citrus fruits by washing them in a solution of borax, which closes the pores of the skin. The application of this process is increasing in California and Florida. Another is as a preservative of wood, in addition to which borax, being non-inflammable, renders it fireproof.

An increased foreign demand stimulated an increased production of this material. The total amount exported from the United States in 1928 was 67,851 short tons valued at $3,454,171, compared with 36,954 short tons valued at $2,422,144 in 1927.

Total Production of Borate Materials in California.

Borax was first discovered in California in the waters of Tuscan Springs in Tehama County, January 8, 1856. Borax Lake in Lake County was discovered in September of the same year by Dr. John A. Veach. This deposit was worked in 1864–1868, inclusive, and during that time produced 1,181,365 pounds of refined borax. The bulk of it was exported by sea, to New York. This was the first commercial output of this salt in the United States, and California is still today the leading American producer of borax, having been for many years the sole producer.

Production from the dry lake 'playa' deposits of Inyo and San Bernardino counties began in 1873; but it was not until 1887 that the borax industry was revolutionized by the discovery of the colemanite beds at Calico, in San Bernardino County, and later similar beds in Inyo and Los Angeles counties. The colemanite deposits of Ventura County are at present unworked, owing to lack of transportation facili-

ties. Some production of colemanite has been made from deposits opened up in Clarke County, Nevada.

The total production of borate materials in California is shown in the following table:

Year	Tons	Value	Year	Tons	Value
1864	12	$9,478	1897	8,000	$1,080,000
1865	126	94,099	1898	8,300	1,153,000
1866	201	132,538	1899	20,357	1,139,882
1867	220	156,137	1900	25,837	1,013,251
1868	32	22,384	1901	22,221	982,380
1869	----------	----------	1902	[a]17,202	2,234,994
1870	----------	----------	1903	34,430	661,400
1871	----------	----------	1904	45,647	698,810
1872	140	89,600	1905	46,334	1,019,158
1873	515	255,440	1906	58,173	1,182,410
1874	915	259,427	1907	53,413	1,200,913
1875	1,168	289,080	1908	22,200	1,117,000
1876	1,437	312,537	1909	16,628	1,163,960
1877	993	193,705	1910	16,828	1,177,960
1878	373	66,257	1911	50,945	1,456,672
1879	364	65,443	1912	42,135	1,122,713
1880	609	149,245	1913	58,051	1,491,530
1881	690	189,750	1914	62,500	1,483,500
1882	732	201,300	1915	67,004	1,663,521
1883	900	265,500	1916	103,523	2,409,375
1884	1,019	198,705	1917	109,944	2,561,958
1885	942	155,430	1918	88,772	1,867,908
1886	1,285	173,475	1919	66,791	1,717,192
1887	1,015	116,689	1920	127,065	2,794,206
1888	1,405	196,636	1921	50,136	1,096,326
1889	965	145,473	1922	[b]39,087	1,068,025
1890	3,201	480,152	1923	62,667	1,893,798
1891	4,267	640,000	1924	52,070	1,599,149
1892	5,525	838,787	1925	46,124	1,526,938
1893	3,955	593,292	1926	47,605	1,625,298
1894	5,770	807,807	1927	72,462	3,043,260
1895	5,959	595,900	1928	109,722	3,378,552
1896	6,754	675,400			
			Totals	1,703,662	$57,994,705

[a] Refined borax. [b] Recalculated to 40% 'anhydrous boric acid' equivalent beginning with 1922.

BROMINE

The first commercial production of bromine and bromine compounds was begun during 1926 by the California Chemical Corporation in its plant at Chula Vista, San Diego County, from salt works bittern waters. This same plant has been recovering magnesium chloride for a number of years. A small amount of bromine was also reported made at a similar bittern-water plant at Newark, Alameda County. The total commercial production of bromine in California amounted to 158 short tons, valued at $120,480, the annual details for the first three years being concealed under the 'Unapportioned' item.

A large part of the bromine output of the United States is not sold as bromine, but in the form of potassium and sodium bromides and other salts. The principal production in the United States has come from bitterns from salt wells in Michigan, Ohio and West Virginia.

The best known uses of bromine are its application in the form of silver bromide in photography and the manufacture of ethyl gasoline. Bromine, as such, was used extensively in the European War in making asphyxiating gases. It also has some uses in medicine, particularly in the treatment of nervous diseases.

CALCIUM CHLORIDE

Bibliography: U. S. Geol. Surv., Min. Res. 1919, Pt. II. Engineering and Contracting, Roads & Streets monthly issue, Feb. 6, 1924. 'How to Maintain Roads,' manual of instruction of Dow Chemical Company.

Calcium chloride is hygroscopic, that is, it has an affinity for water. This property is taken advantage of by utilizing this salt as a drying agent. It is also sprinkled on dirt roads and playgrounds to keep down dust by absorbing moisture. In refrigerating machinery for ice factories, meat-packing houses and cold-storage warehouses, a calcium-chloride solution is stated to have some advantages over salt brine. In fire buckets this solution has an advantage over pure water, in that it has a lower freezing point, does not corrode metal, and tends to keep the buckets full due to its absorbing moisture from the atmosphere. Powdered calcium chloride is used in drying gases, fruits and vegetables.

During 1928 the production of calcium chloride in California came from San Bernardino County from two plants. The annual details are concealed under the 'Unapportioned' item to conceal the output of either operator.

Total Calcium Chloride Production of California.

Commercial production of calcium chloride in California was first reported to the State Mining Bureau in 1921, from two plants in San Bernardino County, being obtained as a by-product in the refining of salt from deposits in certain of the desert dry lakes.

Year	*Tons*	*Value*
1921	683	$22,980
1922 } 1923 } *	1,204	26,580
1924 } 1925 } *	10,988	328,876
1926 } 1927 } *	34,195	508,748
1928	*	*
Totals	47,070	$887,184

* Annual details concealed under 'Unapportioned.'

MAGNESIUM SALTS

Bibliography: State Mineralogist Reports XX, XXI. Bulletin 91. 'Dictionary of Applied Chemistry,' by Thorpe. U. S. Geol. Surv., Min. Res. of P. S.

The 1928 production of magnesium salts in California is concealed under 'unapportioned.' This was nearly all chloride, sold for use in magnesite stucco and cement mixtures (Sorel cement), also some for 'road liquor.' It was in part marketed in the liquid form testing 34°–36° Baumé, and in part as dry crystals, and was prepared from residual bitterns at salt plants in San Diego and San Mateo counties. Part of the San Mateo output is magnesium carbonate, which is used

for a heat insulator. The sulphate marketed was utilized for medicinal and bath purposes.

With the use of magnesite cement and stucco coming more into prominence in building construction on the Pacific Coast, the demand for magnesium chloride is increasing here; but the domestic article has to meet the competition of the cheaper, imported German chloride.

The average value reported for the chloride produced in California in 1928 was approximately $30 per ton, f. o. b. plant.

Total Production of Magnesium Salts in California.

Commercial production of magnesium chloride in California was begun in 1916 by some of the salt companies, from the residual bitterns obtained during the evaporation of sea water for its sodium chloride. In addition, some magnesium sulphate, or 'epsom salts' is also made, annually, but in smaller amount.

The total production of magnesium salts in California, since the beginning of the industry here, is shown in the following tabulation:

Year	*Tons*	*Value*
1916	851	$6,407
1917	1,064	34,973
1918	1,008	29,955
1919	1,616	82,457
1920	3,150	107,787
1921	4,153	106,140
1922	3,036	89,788
1923	3,662	116,031
1924	4,823	145,883
1925	4,221	132,553
1926	4,881	124,470
1927 } 1928 } *	6,241	139,589
Totals	38,706	$1,116,033

* Annual details concealed under 'Unapportioned.'

NITRATES

Bibliography: State Mineralogist Report XV. Bulletins 24, 67, 91. U. S. G. S., Press Bulletin No. 373, July, 1918. Smithsonian Inst., Publ. No. 2421, 1916.

Nitrates of sodium, potassium and calcium have been found in various places in the desert regions of the state, but no deposit of commercial value has been developed as yet. It is hoped that a closer search may some day be rewarded by workable discoveries. At present the principal commercial source of nitrates is the Chilean saltpeter (sodium nitrate) deposits in South America.

The fixation of atmospheric nitrogen electrically has been accomplished successfully in Germany and Scandinavia. The possibilities of cheap hydro-electric power in California make the subject one of interest to us, as we have also the natural raw materials and chemicals to go with the power. Sodium and potassium cyanides can be made by fixation of atmospheric nitrogen electrically,

POTASH

Bibliography: State Mineralogist Reports XV, XVIII, XX, XXII. Bulletins 24, 67, 91. U. S. G. S., Min. Res. 1913, 1914, 1915. Senate Doc. No. 190, 62 Congress, 2d Session. Mining & Sci. Press, Vol. 112, p. 155; Vol. 114, p. 789. Eng. & Min. Jour.-Press, Vol. 117, p. 557, Apr. 5, 1924.

The 1928 production of potash in California came from a single operation in San Bernardino County, the details of which are concealed under the 'Unapportioned' item. The 1928 figures were an increase over the 1927 figures, which were 67,340 short tons, valued at $1,952,-852. This was in part chloride and part from distillery slops char. The quality of the product averaged 60% equivalent K_2O content; and the material was sold principally for fertilizer manufacture.

Imports of crude potash minerals and salts into the United States in 1928, according to the U. S. Bureau of Foreign and Domestic Commerce, amounted to 842,556 long tons, valued at $18,558,213, compared with 623,109 tons and $13,423,925 in 1927. These materials consisted mainly of 'manure salts,' crude chloride (muriate) and sulphate, and kainite, all of which are admitted duty-free.

Quotations have recently ranged from $46 per ton c.i.f. Atlantic and Gulf ports for high-grade sulphate (90%–95%), to $35 per ton for muriate (80%–85%), and $19 for manure salts (30%).

Other uses for potash salts, besides those noted above, are in the manufacture of the best liquid soap and some higher-grade cake soaps, of some finer grades of glass, and in matches. The chemical requirements include tanning, dyeing, metallurgy, electroplating, photography and medicine.

California is the chief source of potash in the United States, as shown by the following article copied from the American Trust Review of the Pacific: [1]

"Governmental agencies and private industry are moving separately, but along similar lines, to relieve the United States of its 75 per cent dependency on foreign sources for the country's huge potash requirements. California is the present chief producer of potash in the United States, and the source of supply is in the saline brines of the dry bed of Searles Lake, San Bernardino County. Other potential sources in the United States are now being investigated, but apart from the Searles Lake deposits, the output of potash is limited to small quantities that are produced as a by-product from various waste materials.

"During the World War America suffered a serious potash famine when supplies were cut off from Germany, the world's largest source of supply, and agriculture, which uses potash in great quantities, was left in a difficult position. Production and quality of essential food crops were adversely affected by the shortage and the small amount of domestic potash available was, in 1915, insufficient to fill even one-half of one per cent of normal consumption requirements. An average of 269,656 short tons of pure potash was imported annually from 1910 to 1913. In 1914 the United States imported 207,089 tons of pure potash from Germany. In 1915, owing to the war embargo and shipping difficulties, imports had fallen to 48,867 tons, and in the three following years the imports had shrunk to less than 8000 tons a year. This scarcity of potash fertilizer was acutely felt in crop production, and consequently led to efforts toward the development of a domestic potash industry.

"In 1915 there was great activity in experimental work and in the erection of plants for the manufacture of potash salts from American sources. In that year a total of 1090 tons of pure potash was produced in this country by five plants. In 1916 the output attained about 4 per cent of the annual potash consumption, and in 1917 it had increasfed to 12 per cent. Stimulated by the exigency of demand and unusually high prices then prevailing, the industry developed rapidly, and in 1918,

[1] American Trust Review of the Pacific, Dec. 15, 1928, pp. 273–276.

the banner year for the United States potash industry, there were 128 plants in operation, whose joint production of pure potash totaled 54,803 tons, or about 20 per cent of the normal pre-war consumption. * * *

"Nature Does Not Replace Potash in Soil.

"The importance of potash as a fertilizer is emphasized by the fact that, like phosphate, it is a plant food found in virgin soil and when exhausted by cultivation is not replaced by nature. It is necessary, therefore, to supply potash to the soil continuously by artificial means. With the nitrates the condition is reversed, for when the land ceases to yield these essentials, the farmer merely allows it to lie fallow for a definite period, or has recourse to sowing leguminous plants, through which procedure nature provides the soil with the requisite nitrates. The question of an adequate and unfailing supply of potash, therefore, is of far-reaching importance to the United States.

"How vitally necessary the mineral is may be understood if we consider the fact that upon abundant supplies of potash depend sufficient supplies of bread, meat, vegetables and fruits. In the wheat and cotton states, tobacco-growing regions, the truck-farming and citrus fruit sections of the country, or whatever special crops are raised by intensive cultivation, the effective fertilization of the soil is not merely an agricultural requirement, but also a national necessity if the present economic status is to be maintained.

"The potash scarcity during the war led to investigations by the government which proved that the soil in certain sections of the country suffered acutely from potash hunger. Upon the application of potash in these regions the crop yields doubled, and it was ascertained by means of special tests that no other ingredients could be substituted for potash. It was specifically shown that truck crops absolutely required a potash soil in order to produce a certain structure in the vegetable tissues that will withstand transportation. Lack of potash in the soil of the truck farms in the southern states was regarded as being mainly responsible for the bad condition in which the bulk of the vegetables reached the northern markets during 1917 and 1918, causing serious loss to the growers. A contributing factor was congestion of traffic, which caused delays in transportation, but soil starvation was held accountable for the major damage.

"It is clearly evident that the problem of obtaining potash at reasonable prices is one that directly affects the health and purse of every person in the country. To some extent the domestic problem also concerns the peoples of other countries who look to the United States for large supplies of foodstuffs. The exports of these agricultural products have been an extremely important factor in maintaining the nation's export balance of trade, and they run into hundreds of millions of dollars yearly. * * *

"Very largely the question of obtaining adequate domestic supplies of potash is concerned with the development of extraction processes at a cost sufficiently low to permit competition in the home markets with the duty-free imported product. It was brought out in the hearings before the House Mines and Mining Committee early this year that the United States is able to obtain in peace times all the potash it requires at a fairly reasonable price, although it becomes expensive when freight charges are added on long inland hauls from seaboard points. The ideal arrangement, said a Department of Agriculture soil expert at the hearing, would be the establishment of potash industries at strategetically situated points throughout the country so that potash could reach the farmer with a minimum of transportation charges. This suggested plan is entirely feasible from the standpoint of potential sources of supply, it was shown, but construction of the necessary plants would have to await the perfection of low-cost production processes.

"Until that time arrives, agriculture and industry will continue to receive the larger part of their potash requirements from Germany. Although indispensable to agriculture, potash is also an important ingredient in the manufacture of many products of modern industry, such as chemicals, medicines, paints, soap, matches, glass, paper, aniline dyes, bleaching agents, explosives and various others. * * *

"For many years prior to the outbreak of the European war the bulk of the potash utilized throughout the world originated in the Stassfurt mines, in the German province of Saxony. This monopoly was achieved through the accessibility and magnitude of the deposits which were then regarded as the only known large bodies of soluble potash, in comparison with which all other world sources dwindled into insignificance. Up to the middle of the last century wood ash constituted the main source of potash. The discovery of the Stassfurt deposits was hailed as a veritable treasure trove, and its exploitation and scientific development eventually led to the world-wide use of potash as an essential ingredient in the manufacture of fertilizers.

"The Stassfurt deposits had been mined near the surface for salt from the thirteenth century, but it was not until 1857 that government engineers, while sinking

shafts in search of further deposits of rock salt, struck a peculiarly bitter salt, designated as 'abraumsalze,' then generally considered worthless and an obstruction to the mining of rock salt. For some time thereafter the abraumsalze was brought to the surface and dumped aside as waste matter. In 1858 it was discovered through chemical research that this apparently useless product was not only an essential in the production of larger and better crops, but could be utilized also for various industrial purposes. It was then that the regular production of potash on a commercial scale was begun, and it has continued in constantly increasing volume ever since.

"Not far from the Stassfurt mine, a new source of potash was found at Anhalt, and this second mine began operations in 1862. Since they first were worked, the two deposits have dominated the world's potash industry. It has been estimated that the Stassfurt deposits contain sufficient potash salts to supply the world for two thousand years, at the present rate of consumption.

"Potash deposits were discovered in Alsace in 1904 as a result of coal-boring operations, and by 1910 the first company was in active production. Others followed in rapid order. The Alsatian deposits, much richer in crude salts than those found in Germany, are said to be sufficient to supply the world for 275 years. Until Alsace was restored to France by the peace conference, potash production in that province was restricted by Germany to 5 per cent of Germany's output in order to safeguard the potash interests of the latter country.

"Onerous as this arrangement might have seemed to the Alsatians, it was in complete harmony with the principles of the cartels, or syndicates, that were formed in Germany to stabilize the potash industry and prevent ruinous competition among the several operating companies. The history of the syndicates and the part played by the imperial German government in fixing prices of potash destined for foreign consumption is long and complicated, but it is sufficient to say that the United States, in the role of chief consumer, for many years paid exorbitant prices for its needed supplies.

"While it is not expected that prices will be advanced under the new potash compact between Germany and France, the fact remains that the United States must continue to be at the mercy of this combination until science discovers an inexpensive process for converting available domsetic materials into the potash of commerce. Some progress already has been made in this respect, and government experts identified with the potash supply investigations believe that the time is not far distant when the country will be producing a greater part of its requirements, if indeed it does not become entirely independent of the Franco-German supply."

Total Production of Potash in California.

Potash production began commercially in California in 1914, with a small yield from kelp. The bulk of the output comes from deposits of potash-bearing residues and brines in the old lake beds of the desert regions, particularly Searles Lake, San Bernardino County. A small amount is made annually from salt-works bitterns, and for a time there was some from Portland cement dust. Some also is obtained from molasses distillery-slops char.

The annual amounts and value of these potash materials, since their beginning in California in 1914, are shown by the following table:

Year	*Tons*	*Value*
1914	10	$460
1915	1,076	19,391
1916	17,908	663,605
1917	129,022	4,202,889
1918	49,381	6,808,976
1919	28,118	2,415,963
1920	26,298	1,465,463
1921	14,806	390,210
1922	17,776	584,388
1923	29,597	709,836
1924	33,107	747,407
1925	36,355	829,770
1926	32,884	812,285
1927	67,340	1,952,852
1928	*	*
Totals	483,678	$21,609,495

* Annual details concealed under 'Unapportioned.'

SALT

Bibliography: State Mineralogist Reports II, XII–XV (inc.), XVII–XXIII (inc.); Bulletins 24, 67, 91. U. S. Geol. Surv., Bull. 669. U. S. Bur. of Mines, Bull. 146.

Most of the salt production in California is obtained by evaporating the water of the Pacific Ocean, plants being located on the shores of San Francisco, Monterey, and San Diego bays, and at Long Beach. Additional amounts are derived from lakes and lake beds in the desert regions, mainly in Inyo, Kern and San Bernardino counties, and evaporation of alkaline lake water in Modoc County. A small amount of valuable medicinal salts is obtained by evaporation of the water of Lake Mono, Mono County.

Distribution of the 1928 salt production of California, by counties, was as follows:

County	*Tons*	*Value*
Alameda	224,000	$611,888
Kern	8,032	40,160
San Bernardino	42,244	186,470
Inyo, Los Angeles, Modoc, Mono,[a] Monterey, San Diego, San Mateo *	66,304	186,138
Totals	340,580	$1,024,656

* Combined to conceal output of a single operator in each.
[a] Medicinal salts.

The above results show an increase in both tonnage and value over the 1927 figures, which were 263,028 tons and $639,127. There were fifteen plants operating in 1928, four of which were in Alameda County.

Production of Salt in California, by Years.

Amount and value of annual production of salt in California from 1887 is shown in the following tabulation:

Year	Tons	Value	Year	Tons	Value
1887	28,000	$112,000	1909	155,680	$414,708
1888	30,800	92,400	1910	174,920	395,417
1889	21,000	63,000	1911	173,332	324,255
1890	8,729	57,085	1912	185,721	383,370
1891	20,094	90,303	1913	204,407	462,681
1892	23,570	104,788	1914	223,806	583,553
1893	50,500	213,000	1915	169,028	368,737
1894	49,131	140,087	1916	186,148	455,695
1895	53,031	150,576	1917	227,825	584,373
1896	64,743	153,244	1918	212,076	806,328
1897	67,851	157,520	1919	233,994	896,963
1898	93,421	170,855	1920	230,638	972,648
1899	82,654	149,588	1921	197,989	832,702
1900	89,338	204,754	1922	223,238	819,187
1901	126,218	366,376	1923	275,979	1,130,670
1902	115,208	205,876	1924	318,800	1,159,137
1903	102,895	211,365	1925	284,068	949,826
1904	95,968	187,300	1926	311,761	1,124,978
1905	77,118	141,925	1927	263,028	639,127
1906	101,650	213,228	1928	340,580	1,024,656
1907	88,063	310,967			
1908	121,764	281,469	Totals	6,104,764	$18,106,717

SODA

Bibliography: State Mineralogist Reports XII, XIII, XV, XVII, XVIII, XX; Bulletins 24, 67, 91. U. S. Geol. Surv., Bull. 717.

The production of sodium salts in California in 1928 included: soda ash, caustic soda and bicarbonate from plants in Owens Lake, Inyo

County, and trona ('sesqui-carbonate,' a double salt of No_2CO_3 and $NaHCO_3$) from Searles Lake, San Bernardino County. There were no shipments of salt cake (sulphate) from the Carrizo Plains, San Luis Obispo County, in 1928. The total amounted to 80,838 tons, valued at $1,469,297, being a slight increase in quantity, but a decrease in value compared with the 1927 figures of 62,571 tons and $1,478,239.

The dense ash and bicarbonate were used mainly in the manufacture of soap, glass, sugar refining, and chemicals; and the trona for metallurgical purposes.

Sodium compounds to some extent replace potassium compounds, in glass and soap making, in photography, in match making, in tanning, sugar refining, and in the manufacture of cyanide for extracting gold and silver from their ores.

Soda Production of California, by Years.

The total output, showing amount and value of these materials in California since the inception of the statistical records of the State Mining Bureau, is given in the table which follows:

Year	Tons	Value	Year	Tons	Value
1894	1,530	$20,000	1912	7,200	$37,094
1895	1,900	47,500	1913	1,861	24,936
1896	3,000	65,000	1914	6,522	115,396
1897	5,000	110,000	1915	5,799	83,485
1898	7,000	154,000	1916	10,593	264,825
1899	10,000	250,000	1917	24,505	928,578
1900	1,000	50,000	1918	20,447	855,423
1901	8,000	400,000	1919	21,294	721,958
1902	7,000	50,000	1920	32,407	1,164,898
1903	18,000	27,000	1921	14,828	438,996
1904	12,000	18,000	1922	20,084	573,661
1905	15,000	22,500	1923	34,885	764,284
1906	12,000	18,000	1924	32,536	711,796
1907			1925	48,625	947,649
1908	9,600	14,400	1926	63,333	1,305,802
1909	7,712	11,593	1927	62,571	1,478,239
1910	8,125	11,862	1928	80,838	1,469,297
1911	9,023	52,887			
			Totals	624,218	$13,209,059

CHAPTER SEVEN

BY COUNTIES

Introductory.

The State of California includes a total area of 158,297 square miles, of which 155,652 square miles are of land. The maximum width is 235 miles, the minimum 148 miles, and the length from the northwest corner to the southeast corner is 775 miles. The state is divided into fifty-eight counties. The 1920 census figures show a total population for California of 3,437,709. A 1928 estimate by the State Controller places the figure that year at 5,466,104. Minerals of commercial value exist in every county, and during 1928 some active production was reported to the State Division of Mines from all of the fifty-eight.

Rank of Counties in Mineral Yield, 1928.

Of the first ten counties, in point of total output for 1928, the first four, Los Angeles, Kern, Orange and Ventura, owe their position mainly to petroleum, as does Santa Barbara (seventh) and Fresno (eighth). Los Angeles, due to its oil, leads all the others, being credited with 43% of the entire state's total value for 1928, having passed Kern in 1923, which led for many years. San Bernardino (fifth) owes its place chiefly to cement, potash, borax, mineral water, silver and stone; Riverside (sixth) to cement, stone, clay, brick and tile; Plumas (ninth) to copper; and San Mateo (tenth) to cement. There were twenty-three counties, each having a total mineral production in excess of a million dollars in 1928. Cement was an important item in eight counties, gold in four, miscellaneous stone in two, and copper, soda, borax, in one each. In the point of variety and diversity San Bernardino County led all others in 1928, with a total of 20 different mineral products on its commercial list, followed by Riverside with 19; Kern, Los Angeles, and San Diego with 17 each; Inyo with 15; Fresno with 13; Imperial and Tuolumne with 11 each; Butte, Calaveras, Plumas, Santa Barbara and Shasta with 10 each. The counties with their mineral resources, production for 1928, etc., are considered in detail in the following paragraphs.

County	*Value*	*County*	*Value*
1. Los Angeles	$144,835,988	31. Stanislaus	$472,158
2. Kern	43,064,781	32. Siskiyou	471,166
3. Orange	39,655,177	33. Marin	449,568
4. Ventura	31,116,675	34. Tulare	445,366
5. San Bernardino	14,157,381	35. Del Norte	381,358
6. Riverside	6,274,901	36. Tuolumne	376,278
7. Santa Barbara	4,577,650	37. Monterey	351,660
8. Fresno	4,227,286	38. Placer	333,135
9. Plumas	3,599,127	39. El Dorado	329,427
10. San Mateo	3,328,573	40. Napa	306,262
11. Santa Cruz	3,323,920	41. Humboldt	300,227
12. Calaveras	2,802,542	42. Mariposa	282,201
13. Amador	2,644,179	43. Imperial	241,678
14. Yuba	2,529,076	44. San Luis Obispo	217,125
15. Alameda	2,421,830	45. Mono	214,420
16. Sacramento	2,389,645	46. Sonoma	212,568
17. Contra Costa	2,100,482	47. Lake	189,103
18. Nevada	2,023,886	48. Glenn	101,889
19. Inyo	1,832,567	49. Lassen	76,499
20. San Diego	1,770,253	50. San Francisco	67,430
21. San Benito	1,654,718	51. Solano	57,451
22. Shasta	1,114,729	52. Mendocino	40,490
23. Santa Clara	1,021,541	53. Colusa	36,500
24. Sierra	679,925	54. Modoc	30,440
25. Merced	653,187	55. Yolo	17,200
26. Butte	640,272	56. Tehama	14,389
27. San Joaquin	624,931	57. Alpine	8,529
28. Kings	577,819	58. Sutter	2,000
29. Trinity	530,180		
30. Madera	514,495	Total	$332,714,233

ALAMEDA

Land area: 732 square miles.
Population: 344,177 (1920 census).
Location: East side of San Francisco Bay.
County seat: Oakland.
References: State Mineralogist Report XVII: XVIII: XX.

Alameda county, while in no sense one of the 'mining counties,' comes fifteenth on the list, with a value of mineral products for 1928 of $2,421,830, a decrease from the 1927 total, which was $2,577,787.

The mineral resources of this county include asbestos, brick, chromite, clay, coal, copper, gold, limestone, quartz crystals, glass-sand, sandstone, silver, soapstone, and miscellaneous stone.

Commercial production for 1928 was as follows:

Substance	*Amount*	*Value*
Brick and hollow building tile	------	$505,386
Clay (pottery)	27,189 tons	17,071
Salt	224,000 tons	611,888
Stone, miscellaneous	------	1,267,155
Other minerals *	------	20,330
Total value		$2,421,830

* Includes pyrite and travertine.

ALPINE

Land area: 776 square miles.
Population: 243 (1920 census).
Location: On eastern border of state, south of Lake Tahoe.
County seat: Markleeville.
References: State Mineralogist Report XV: XVII: XVIII.

This county lies just south of Lake Tahoe, in the high Sierra Nevada. Transportation is by auto, wagon, or mule back, and facilities in general are lacking to promote development work.

The mineral resources of this section are varied and the country has not yet been thoroughly prospected. Occurrences of barium, copper, gold, gypsum, lead, limestone, pyrite, rose quartz, silver, tourmaline, and zinc have been noted here.

Commercial production for 1928 was $8,529, being an increase over the 1927 amount, which was $5,306.

Substance	*Amount*	*Value*
Gold	----	$23
Lead	3,001 lbs.	174
Silver	621 fine oz.	363
Stone, miscellaneous	----	2,800
Other minerals *	----	5,169
Total value		$8,529

* Includes copper and granite.

AMADOR

Land area: 601 square miles.
Population: 7793 (1920 census).
Location: East-central part of state—Mother Lode District.
County seat: Jackson.
References: State Mineralogist Report XIV: XVII: XVIII: XIX: XX: XXIII (April, 1927).

The value of Amador County's mineral production increased from $2,207,798 in 1927 to $2,644,179, placing it number thirteen on the list of counties in the state as regards total value of mineral substances marketed. The decrease was due mainly to gold.

Although having an output consisting of nine different minerals, the leading product, gold, makes up approximately 87% of the total value for the year.

Amador at one time led the state in gold production, though exceeded in 1920–1923 and in 1926–1927 by Yuba and Nevada counties, but in 1925 and 1928 by Yuba only.

Commercial output for 1928 was as follows:

Substance	*Amount*	*Value*
Clay (pottery)	96,209 tons	$116,000
Copper	1,402 lbs.	202
Gold	-----	2,236,922
Silver	24,473 fine oz.	14,317
Stone, miscellaneous	-----	189,900
Other minerals *	-----	86,838
Total value		$2,644,179

* Includes brick and coal.

BUTTE

Land area: 1722 square miles.
Population: 30,030 (1920 census).
Location: North-central portion of state.
County seat: Oroville.
References: State Mineralogist Report XV: XVII: XVIII: XXIV (July, 1928).

Butte, twenty-sixth county in California in regard to value of its mineral output, reports a commercial production of ten mineral substances, having a total value of $640,308 as compared with $308,139 in 1927. As will be noted in the following tabulation, gold is the most important item. Butte stands tenth among the gold-producing counties of the state. Among the mineral resources of this section are asbestos, barytes, chromite, gems, gold, limestone, marble, mineral water, platinum group, silver and miscellaneous stone.

Commercial value for 1928 was as follows:

Substance	*Amount*	*Value*
Brick	960 M.	$16,320
Gold	-----	48,432
Mineral water	2,190 gals.	1,045
Silver	1,246 fine oz.	729
Stone, miscellaneous	-----	556,301
Other minerals *	-----	17,481
Total value		$640,308

* Includes copper, gems (diamonds, sapphires), natural gas and soapstone.

CALAVERAS

Land area: 1027 square miles.
Population: 6183 (1920 census).
Location: East-central portion of state—Mother Lode District.
County seat: San Andreas.
References: State Mineralogist Report XIV: XVII: XVIII: XIX: XX: XXI (April, 1925).

Calaveras County reported production of ten different minerals, valued at $2,802,542 during the year 1928, as compared with $1,608,714 for 1927. Cement, stone, gold, and copper are the chief mineral substances. Calaveras County stands twelfth among the counties in regard to the total value of mineral output for 1928, and tenth in gold.

The principal mineral resources developed and undeveloped are: Asbestos, chromite, clay, copper, fuller's earth, gold, limestone, marble, mineral paint, mineral water, platinum group, pyrite, quartz crystals, silver, soapstone, and miscellaneous stone.

Commercial output for 1928 was as follows:

Substance	*Amount*	*Value*
Copper	150,911 lbs.	$21,731
Gold	------	162,372
Lead	2,817 lbs.	163
Silver	2,511 fine oz.	1,469
Stone, miscellaneous	------	557,020
Other minerals *	------	2,059,787
Total value		$2,802,542

* Includes cement, gems (quartz crystals), mineral water, platinum, soapstone.

COLUSA

Land area: 1140 square miles.
Population: 9920 (1920 census).
Location: Sacramento Valley.
County seat: Colusa.
References: State Mineralogist Report XIV: XVII, XVIII, XXV (April, 1929).

Colusa County lies largely in the basin of the Sacramento Valley. Its western border, however, rises into the foothills of the Coast Range of mountains, and its mineral resources—largely undeveloped—include coal, chromite, copper, gypsum, manganese, mineral water, pyrite, quicksilver, sandstone, miscellaneous stone, sulphur, and in some places traces of gold and silver.

The value of the 1928 mineral production was $36,500, being an increase from the 1927 figures which were $13,207, giving it fifty-third place in the order of mineral value, and was as follows:

Substance	*Value*
Stone, miscellaneous	$16,500
Unapportioned	20,000
Total value	$36,500

CONTRA COSTA

Land area: 714 square miles.
Population: 53,889 (1920 census).
Location: East side of San Francisco Bay.
County seat: Martinez.
References: State Mineralogist Report XVII: XVIII: XXIII (Jan., 1927).

Contra Costa, like Alameda County, lies on the eastern shore of San Francisco Bay, and is not commonly considered among the mineral producing counties of the state. It stands seventeenth on the list in this respect, with an output valued at $2,100,482 for the calendar year 1928. Various structural materials make up the chief items, including brick, cement, limestone, and miscellaneous stone. Among the others are asbestos, clay, coal, gypsum, manganese, mineral water, and soapstone.

Commercial production for 1928 was as follows:

Substance	*Value*
Stone, miscellaneous	$590,792
Other minerals *	1,609,690
Total value	$2,100,482

* Includes brick and hollow building tile, cement, clay (pottery), coal and mineral water.

DEL NORTE

Land area: 1024 square miles.
Population: 2759 (1920 census).
Location: Extreme northwest corner of state.
Transportation: Motor, wagon and mule back; steamer from Crescent City.
County seat: Crescent City.
References: State Mineralogist Report XIV: XVII: XXI (July, 1925).

Del Norte almost rivals Alpine County in regard to inaccessibility. Like the latter county, also, given transportation and kindred facilities, this portion of the state presents a field for development along mining lines especially. Its chief mineral resources, largely untouched, are chromite, copper, gems, gold, iron, platinum group, silver, and miscellaneous stone.

The 1928 output was an increase from the figure of $53,975 in 1927, the principal item of which is crushed rock used on highway construction, and rock used on the Crescent City harbor jetty.

Commercial production for 1928, giving it thirty-fifth place, was as follows:

Substance	*Amount*	*Value*
Gold	--	$277
Silver	2 fine oz.	1
Stone, miscellaneous	--	381,080
Total value		$381,358

EL DORADO

Land area: 1753 square miles.
Population: 6426 (1920 census).
Location: East-central portion of the state, northernmost of the Mother Lode counties.
County seat: Placerville.
References: State Mineralogist Report XV: XVII: XVIII: XIX: XX: XXII (Oct., 1926).

El Dorado County, which contains the locality where gold in California was first heralded to the world, comes thirty-ninth on the list of counties ranked according to the value of their total mineral production during the year 1928. In addition to the segregated figures here given, a large tonnage of limestone is annually shipped from El Dorado for use in cement manufacture, and whose value is included in the state total for cement. The 1928 mineral production was an increase from $245,435 in 1927.

The mineral resources of this section, many of them undeveloped, include asbestos, barytes, chromite, clay, copper, gems, gold, iron, molybdenum, limestone, quartz crystals, quicksilver, slate, soapstone, silver, and miscellaneous stone.

Commercial production for 1928 was as follows:

Substance	*Amount*	*Value*
Copper	1,074 lbs.	$155
Gold	-----	122,017
Limestone	57,012 tons	158,252
Soapstone	365 tons	8,855
Silver	1,191 fine oz.	697
Stone, miscellaneous	-----	17,455
Other minerals *	-----	21,995
Total value		$329,427

* Includes lead, silica, slate.

FRESNO

Land area: 5950 square miles.
Population: 128,779 (1920 census).
Location: South-central portion of state.
County seat: Fresno.
References: State Mineralogist Report XIV: XVII: XVIII: XXV (July, 1929).

Fresno County, eighth in importance as a mineral producer among the counties of California, reported an output for 1928 of thirteen mineral substances, with a total value of $4,227,286, a decrease from the reported 1927 production which was worth $7,547,216.

The bulk of the above is derived from the petroleum production of the Coalinga field, with miscellaneous stone also important.

The mineral resources of this county are many, and, aside from crude oil, are in the main not fully developed. They include asbestos, barytes, brick, chromite, copper, gems, gold, graphite, gypsum, magnesite, natural gas, petroleum, quicksilver, and miscellaneous stone.

Commercial production for 1928 was as follows:

Substance	*Amount*		*Value*
Gold	-------		$15,455
Granite	1,376	cu. ft.	80,050
Natural gas	1,422,366	M cu. ft.	151,061
Petroleum	4,611,440	bbls.	3,524,985
Silver	128	fine oz.	75
Stone, miscellaneous	-------		362,260
Other minerals *	-------		93,400
Total value			$4,227,286

* Includes brick and hollow building tile, copper, gems (white, blue, brown topaz), mineral water, pumice and quicksilver.

GLENN

Land area: 1259 square miles.
Population: 11,853 (1920 census).
Location: West side of Sacramento Valley.
County seat: Willows.
References: State Mineralogist Report XIV: XVII: XVIII.

Glenn County, standing forty-eighth, owes its position among the mineral-producing counties of the state mainly to the presence of large deposits of sand and gravel which are annually worked, the product being used for railroad ballast, etc. In 1917 and 1918, chromite was also an important item. In the foothills in the western portion of the county, deposits of chromite, copper, manganese, sandstone, and soapstone have been found.

Commercial production for 1928 was as follows, being an increase from $63,869 of the previous year:

Substance	*Value*
Stone, miscellaneous	$101,889

HUMBOLDT

Land area: 3634 square miles.
Population: 37,857 (1920 census).
Location: Northwestern portion of state, bordering on Pacific Ocean.
County seat: Eureka.
References: State Mineralogist Report XIV: XVII: XVIII: XXI (July, 1925).

Humboldt County is almost entirely mountainous, transportation within its limits being very largely by auto and wagon road, and trail, and until 1915, when railroad communication was established with the outside world, previously the only method of outside communication was by steamer. The county is rich in mineral resources, among which are brick, chromite, coal, clay, copper, gold, iron, mineral water, natural gas, petroleum, platinum, silver, and miscellaneous stone.

Humboldt ranks forty-first in the value of its mineral output among the counties of the state for 1928 with six different mineral substances, valued at $300,227, as compared with the 1927 output valued at $562,802.

Commercial production for 1928 was as follows:

Substance	*Amount*	*Value*
Gold	--	$1,788
Silver	12 fine oz.	7
Stone, miscellaneous	--	291,491
Other minerals *	--	6,941
Total value		$300,227

* Includes brick and natural gas.

IMPERIAL

Land area: 4089 square miles.
Population: 43,383 (1920 census).
Location: Extreme southeast corner of the state.
County seat: El Centro.
References: State Mineralogist Report XIV: XVII: XVIII: XIX: XX: XXII (April, 1926).

During 1928 Imperial County produced eleven mineral substances having a total value of $241,678, a decrease from the 1927 output, which was $350,977. It ranks forty-third in total value of mineral production for the year. This county contains deposits of cyanite, gold, gypsum, lead, manganese, marble, pumice, salt, silver, sodium, and strontium, largely undeveloped.

Commercial production for 1928 was as follows:

Substance	*Amount*	*Value*
Gold	--	$25
Silver	2 fine oz.	1
Stone, miscellaneous	--	98,790
Other minerals *	--	142,862
Total value		$241,678

* Includes brick, copper, cyanite, feldspar, gypsum, pumice, silica.

INYO

Land area: 10,019 square miles.
Population: 7031 (1920 census).
Location: Lies on eastern border of state, north of San Bernardino County.
County seat: Independence.
References: State Mineralogist Report XV: XVII: XVIII: XX: XXII (Oct., 1926).

Inyo, the second largest county in the state, and containing less than one inhabitant per square mile, is extremely interesting from a mineralogical point of view. It is noted because of the fact that within its borders are located both the highest point, Mount Whitney (elevation 14,502 feet), and the lowest point, Death Valley (elevation 290 feet below sea level), in the United States. In the higher mountainous sections are found many vein-forming minerals, and in the lake beds of Death Valley saline deposits exist.

Inyo mineral production during the year 1928 reached a value of $1,832,567, standing nineteenth among the counties of the state in this respect. Fifteen different mineral substances were produced. The

1927 output was valued at $2,519,834. Its mineral resources include antimony, asbestos, barytes, borates, copper, dolomite, gems, gold, gypsum, lead, marble, soda, sulphur, talc, tungsten, and zinc.

Commercial production for 1928 was as follows:

Substance	*Amount*	*Value*
Copper	22,250 lbs.	$3,204
Gold	--------	10,781
Lead	1,733,120 lbs.	100,421
Pumice and volcanic ash	163 tons	1,630
Silver	40,937 fine oz.	23,948
Soda	68,664 tons	1,292,165
Stone, miscellaneous	--------	44,831
Talc	8,563 tons	121,177
Other minerals *	--------	234,410
Total value		$1,832,567

* Includes borates, dolomite, fuller's earth, gems, 'granite' (tuff), salt and tungsten.

KERN

Land area: 8003 square miles.
Population: 54,843 (1920 census).
Location: South-central portion of state.
County seat: Bakersfield.
References: State Mineralogist Report XIV: XVII: XVIII: XXIX: XX: XXV (Jan., 1929).

Kern County, because of its immensely productive oil fields, for many years stood preeminent among all counties of California in the value of its mineral output, the exact figures for 1928 being $43,064,781. Kern was surpassed by both Los Angeles and Orange counties in 1923, but by Los Angeles, only, in 1924–1928, for which petroleum also is responsible. The 1927 mineral output for this county was worth $64,729,488. The decrease was due to a smaller quantity and lower prices of crude oil. During 1928 seventeen different mineral substances were produced. Among the mineral resources, developed and undeveloped, of this section are antimony, asphalt, borax, brick, clay, cement, copper, feldspar, fuller's earth, gems, gold, gypsum, iron, lead, limestone magnesite, marble, mineral paint, natural gas, petroleum, potash, pumice, salt, silica, silver, soapstone, soda, sulphur, and tungsten.

Commercial production for 1928 was as follows:

Substance	*Amount*	*Value*
Brick	2,126 M	$30,791
Gold	--------	186,453
Natural gas	35,107,062 M cu. ft.	1,916,797
Petroleum	44,096,638 bbls.	36,803,054
Silver	8,966 fine oz.	5,245
Stone, miscellaneous	--------	78,663
Other minerals *	--------	4,043,778
Total value		$43,064,781

* Includes antimony, borates, cement, clay (pottery), feldspar, fuller's earth, gypsum, lime, pumice, salt.

KINGS

Land area: 1559 square miles.
Population: 22,031 (1920 census).
Location: South-central portion of the state.
County seat: Hanford.
References: State Mineralogist Report XIV: XVII: XVIII.

Little development has taken place in Kings County along mineral lines to date. Deposits of fuller's earth, gypsum, mineral paint,

natural gas, and quicksilver, of undetermined extent, have been found in the county. Drilling for oil has been under way, and commercial output recorded for the first time in 1926.

Tulare Lake is in Kings County, though now largely drained, and the land under cultivation.

Kings County is twenty-eighth in value of mineral production for 1928, accounted for by the bringing in of oil wells at Kettleman Hills.

Commercial output for 1928 was as follows:

Substance	*Amount*	*Value*
Petroleum	198,784 bbls.	$576,474
Stone, miscellaneous	------	1,240
Unapportioned	------	105
Total value		$577,819

LAKE

Land area: 1278 square miles.
Population: 5542 (1920 census).
Location: About fifty miles north of San Francisco Bay and the same distance inland from the Pacific Ocean.
County seat: Lakeport.
References: State Mineralogist Report XIV: XVII: XVIII: XX: XXV (July, 1929).

On account of its topography and natural beauties, Lake County is sometimes referred to as the Switzerland of America. The mineral resources which exist here are many and varied, actual production being comparatively small, as shown by the table below, and in the past composed mainly of quicksilver and mineral water. Some of the leading minerals found in this section, in part as yet undeveloped, are asbestos, borax, chromite, clay, copper, gems, gold, gypsum, mineral water, quicksilver, silver, and sulphur.

Lake County was in forty-seventh place as to value of mineral output. Commercial production for 1928 was as follows:

Substance	*Amount*	*Value*
Mineral water	123,500 gals.	$22,750
Natural gas	1,000 M cu. ft.	500
Quicksilver	1,206 flasks	145,718
Stone, miscellaneous	------	19,395
Unapportioned	------	740
Total value		$189,103

LASSEN

Land area: 4531 square miles.
Population: 8507 (1920 census).
Location: Northeast portion of state.
County seat: Susanville.
References: State Mineralogist Report XV: XVII: XVIII: XIX: XXV (Jan., 1929).

Lassen County is one of the only partly-developed sections of California. Since about 1912 a railroad traversing the county north and south has been in operation, thus affording opportunity for development along mineral and other lines.

Among the mineral resources of this county are copper, gems, gypsum, gold, silver, and sulphur. In the past, some gold had been pro-

duced, but not for some years, until 1921, when the yield again became important. In forty-ninth place, commercial production for 1928 was as follows:

Substance	*Amount*	*Value*
Gold	----	$492
Granite	1,550 cu. ft.	2,600
Silver	14 fine oz.	8
Stone, miscellaneous	----	73,399
Total value		$76,499

LOS ANGELES

Land area: 4067 square miles.
Population: 936,438 (1920 census).
Location: One of the southwestern coast counties.
County seat: Los Angeles.
References: State Mineralogist Report XV: XVII: XVIII: XIX: XX: XXIII (July, 1927).

Mineral production in Los Angeles County for the year 1928 amounted in value to $144,835,988, as compared to the 1927 output worth $131,832,441. This accounted for 43% of the entire state's total for 1928, and ranks Los Angeles first in the state as a mineral producer, having in 1923 passed Kern County, which had been leading for several years. The increase is 1928 was due to an increased production of petroleum.

Its output of brick and tile was over three million dollars, and that of petroleum amounted to over one hundred fourteen million dollars. Among the mineral resources may be noted asphalt, barytes, borax, brick, clay, fuller's earth, gems, gold, gypsum, infusorial earth, limestone, marble, mineral paint, mineral water, natural gas, petroleum, salt, glass-sand, sandstone, serpentine, silver, soapstone, and miscellaneous stone. Some potash has been obtained from kelp.

Commercial production for 1928, consisting of seventeen substances, was as follows:

Substance	*Amount*	*Value*
Brick	148,392 M	$2,191,943
Building tile (hollow)	29,302 tons	577,397
Clay (pottery)	99,781 tons	55,539
Gold	----------	2,187
Granite	9,350 cu. ft.	3,240
Mineral water	10,929,535 gals.	538,110
Natural gas	110,432,906 M cu. ft.	9,058,485
Petroleum	120,549,303 bbls.	126,709,373
Silver	34 fine oz.	20
Stone, miscellaneous	----------	5,622,815
Other minerals *	----------	76,879
Total value		$144,835,988

* Includes diatomaceous earth, lead, limestone, salt, sandstone, titanium.

MADERA

Land area: 2112 square miles.
Population: 12,203 (1920 census).
Location: East-central portion of state.
County seat: Madera.
References: State Mineralogist Report XIV: XVII: XVIII: XXIV (Oct., 1928).

Madera County produced five different mineral substances during the year 1928, having a total value of $514,495, as compared with the

1927 output worth $1,059,666, the decrease being due to granite. This county contains deposits of copper, gold, granite, iron, lead, molybdenum, pumice, silver, and miscellaneous stone.

In thirtieth place, commercial production for 1928 was as follows:

Substance	*Amount*	*Value*
Copper	14,171 lbs.	$2,031
Gold	-----	3,580
Silver	246 fine oz.	144
Other minerals *	-----	508,740
Total value		$514,495

* Includes miscellaneous stone and granite.

MARIN

Land area: 529 square miles.
Population: 27,342 (1920 census).
Location: Adjoins San Francisco on the north.
County seat: San Rafael.
References: State Mineralogist Report XIV: XVII: XVIII: XXII (July, 1926).

Mineral production in Marin County during 1928 amounted to $449,568, compared with $527,004 in 1927.

This county is not especially prolific in minerals, although among its resources along these lines are brick, gems, manganese, mineral water, soapstone, and miscellaneous stone.

In thirty-third place, commercial production for 1928 was as follows:

Substance	*Value*
Stone, miscellaneous	$309,218
Other minerals *	140,350
Total value	$449,568

* Includes brick and mineral water.

MARIPOSA

Land area: 1453 square miles.
Population: 2775 (1920 census).
Location: Most southerly of the Mother Lode counties. East-central portion of state.
County seat: Mariposa.
References: State Mineralogist Report XIV: XVII: XVIII: XXIV (April, 1928).

Mariposa County is one of the distinctly 'mining' counties of the state, although it stands but forty-second on the list of counties in regard to the value of its mineral output for 1928, with a total of $282,201, as compared with $499,878 in 1927.

Its mineral resources are varied; among the more important items being barytes, copper, gems, gold, lead, marble, silver, slate, soapstone, and miscellaneous stone.

The Yosemite Valley is in Mariposa County.

Commercial production for 1928 was as follows:

Substance	*Amount*	*Value*
Gold	----	$120,568
Granite	----	13,988
Silica	3,728 tons	21,776
Silver	3,359 fine oz.	2,199
Stone, miscellaneous	----	68,037
Other minerals *	----	55,597
Total value		$282,201

* Includes barytes and copper.

MENDOCINO

Land area: 3453 square miles.
Population: 24,116 (1920 census).
Location: Joins Humboldt County on the south and bounded by the Pacific Ocean on the west.
County seat: Ukiah.
References: State Mineralogist Report XIV: XVII: XVIII: XIX: XX.

Mendocino County's annual mineral production has usually been small, the 1928 output being valued at $40,490, ranking fifty-second among counties, as compared with $47,670 in 1927.

Deposits of in part undetermined value of asbestos, chromite, coal, copper, graphite, magnesite, and mineral water have been found, as well as traces of gold, platinum, and silver.

Commercial production for 1928 was as follows:

Substance	*Value*
Stone, miscellaneous	$40,420
Unapportioned	70
Total value	$40,490

MERCED

Land area: 1995 square miles.
Population: 24,579 (1920 census).
Location: About the geographical center of the state.
County seat: Merced.
References: State Mineralogist Report XIV: XVII: XVIII: XXI (April, 1925).

Merced County as a whole lies in the San Joaquin Valley and it figures as one of the lesser mineral producing counties of the state. The 1928 mineral output was valued at $653,187, compared with $366,873 in 1927, the increase being due to cement.

Gold, platinum, and silver were formerly obtained in important amounts by dredging, which ceased in this county in 1918, though a small yield from other sources is still occasionally had. Undeveloped deposits of antimony, magnesite, quicksilver, and limestone have been noted in this county in addition to the foregoing.

In twenty-fifth place, commercial production during 1928 was as follows:

Substance	*Amount*	*Value*
Gold	--	$310
Silver	3 fine oz.	2
Other minerals *	--	652,875
Total value		$653,187

* Includes brick and hollow building tile, cement, clay (pottery), miscellaneous stone.

MODOC

Land area: 3823 square miles.
Population: 5425 (1920 census).
Location: The extreme northeast corner of the state.
County seat: Alturas.
References: State Mineralogist Report XV: XVII: XVIII: XXV (Jan., 1929).

Modoc County, like Lassen, has only in recent years had the benefit of communication with the outside world by rail. Among its known mineral resources are clay, coal, gold, iron, quicksilver, salt, and silver.

In fifty-fourth place, commercial production for 1928 was as follows:

Substance	*Value*
Stone, miscellaneous	$29,440
Unapportioned	1,000
Total value	$30,440

MONO

Land area: 3030 square miles.
Population: 960 (1920 census).
Location: Is bordered by the state of Nevada on the east and is about in the central portion of the state measured on a north and south line.
County seat: Bridgeport.
References: State Mineralogist Report XV: XVII: XVIII: XX: XXIII (Oct., 1927).

Gold mining has been carried on in portions of Mono County for many years, although, taken as a whole, it lies in a somewhat inaccessible country so far as rail transportation is concerned. It is in the continuation of the highly mineralized belt which was noted in Inyo County and contains among other mineral resources barytes, clay, copper, gold, limestone, molybdenum, pumice, salt, silver, and travertine.

In forty-fifth place, commercial production for 1928 was as follows:

Substance	*Amount*	*Value*
Gold	------	$6,307
Silver	301,052 fine oz.	176,115
Other minerals *	------	31,998
Total value		$214,420

* Includes clay (pottery), pumice and volcanic ash, salt and travertine.

MONTEREY

Land area: 3330 square miles.
Population: 27,980 (1920 census).
Location: West-central portion of state, bordering on Pacific Ocean.
County seat: Salinas.
References: State Mineralogist Report XV: XVII: XVIII: XIX: XXI (Jan., 1925).

Monterey County produced six different mineral substances during 1928, having a total value of $351,660, as compared with the 1927 output worth $351,049. Its mineral resources include brick, clay, copper, coal, diatomaceous earth, dolomite, feldspar, fuller's earth, gold,

gypsum, limestone, mineral water, petroleum, quicksilver, glass-sand, sandstone, silver, and miscellaneous stone.

In thirty-seventh place, commercial production for 1928 was as follows:

Substance	*Amount*	*Value*
'Sandstone' (shale building stone)	94,700 cu. ft.	$22,200
Stone, miscellaneous	-----	210,489
Other minerals *	-----	118,971
Total value		$351,660

* Includes clay (pottery), diatomaceous earth, dolomite and salt.

NAPA

Land area: 783 square miles.
Population: 20,678 (1920 census).
Location: Directly north of San Francisco Bay—one of the 'bay counties.'
County seat: Napa.
References: State Mineralogist Report XIV: XVII: XVIII: XX: XXV (April, 1929).

Napa, because of its production of structural and industrial materials and mineral water, stands fortieth on the list of mineral-producing counties in California. Its mineral resources include chromite, copper, magnesite, mineral water, quicksilver, sandstone, and miscellaneous stone. In the past this county has been one of the important producers of quicksilver.

In 1928 the value of the output was $306,262, as compared with the 1927 output worth $417,229.

Commercial production for 1928 was as follows:

Substance	*Amount*	*Value*
Mineral water	70,291 gals.	$32,707
Quicksilver	781 flasks	85,477
Stone, miscellaneous	-----	179,078
Unapportioned	-----	9,000
Total value		$306,262

NEVADA

Land area: 974 square miles.
Population: 10,860 (1920 census).
Location: North of Lake Tahoe, on the eastern border of the state.
County seat: Nevada City.
References: State Mineralogist Report XVI: XVII: XVIII: XIX: XX.

Nevada, one of the mountain counties of California, for some years alternated with Amador in the gold lead, but both were passed by Yuba in 1918–1921, also 1923. In 1922 and 1924, Nevada led, but dropped to third place in 1925 and 1928, holding second place in 1926 and 1927. Nevada County stands eighteenth on the list of counties in regard to value of its total mineral output for 1928, with a production worth $2,023,886, as compared with the 1927 production worth $2,213,709, the decrease being due to gold and miscellaneous stone.

While this county actually produces mainly gold and silver, its resources cover a wide scope, including antimony, asbestos, barytes,

chromite, clay, copper, gems, iron, lead, mineral paint, pyrites, soapstone, and tungsten.

Commercial production for 1928 was as follows:

Substance	*Amount*	*Value*
Gold	-----	$1,994,002
Silver	35,557 fine oz.	20,798
Stone, miscellaneous	-----	4,000
Other minerals *	-----	5,086
Total value		$2,023,886

* Includes copper, granite, lead.

ORANGE

Land area: 795 square miles.
Population: 61,375 (1920 census).
Location: Southwestern portion of state, bordering Pacific Ocean.
County seat: Santa Ana.
References: State Mineralogist Report XV: XVII: XVIII: XIX: XX: XXI (Jan., 1925).

Orange County is one of the many in California which on casual inspection appears to be anything but a mineral producing section. It stood for many years, however, as the second county in the state in regard to the total value of mineral output, on account of its highly productive oil fields. It was passed in 1922 by Los Angeles, the credit for which is also due to oil, and in turn Orange passed Kern County in 1923, but dropped back to third in 1924–1926.

This county showed a mineral production for 1928 of $39,655,177, compared with the 1927 output worth $60,547,041, the decrease being due to low petroleum prices and decreased production. Orange passed Shasta County in 1917, which previously for a number of years had exceeded all other counties in California, except Kern.

Aside from the substances actually produced and noted in the table below, coal, gypsum, iron, infusorial earth, sandstone, and tourmaline have been found in Orange County.

Commercial production for 1928 was as follows:

Substance	*Amount*	*Value*
Clay (pottery)	98,392 tons	$87,245
Natural gas	45,411,009 M cu. ft.	4,695,769
Petroleum	37,100,943 bbls.	34,607,932
Stone, miscellaneous	-----	244,634
Other minerals *	-----	19,597
Total value		$39,655,177

* Includes brick and quicksilver.

PLACER

Land area: 1395 square miles.
Population: 18,584 (1920 census).
Location: Eastern border of state directly west of Lake Tahoe.
County seat: Auburn.
References: State Mineralogist Report XV: XVII: XVIII: XIX: XX: XXIII (July, 1927).

While standing only thirty-eighth on the list of mineral producing counties, Placer contains a wide variety of mineral substances, some of which have not been commercially exploited. Its leading products

include gold, chromite, granite, copper, and clay. Other mineral resources are asbestos, brick, coal, gems, iron, lead, limestone, magnesite, manganese, marble, quartz crystals, glass-sand, silver, and miscellaneous stone.

Commercial production for 1928 was as follows, compared to a total value of $360,224 for the previous year:

Substance	*Amount*	*Value*
Clay (pottery)	110,353 tons	$163,644
Gold	------	71,959
Granite	12,370 cu. ft.	19,655
Silver	578 fine oz.	338
Stone, miscellaneous	------	23,096
Other minerals *	------	54,443
Total value		$333,135

* Includes brick and hollow building tile, copper, mineral paint, mineral water.

PLUMAS

Land area: 2594 square miles.
Population: 5681 (1920 census).
Location: Northeastern border of state, south of Lassen County.
County seat: Quincy.
References: State Mineralogist Report XVI: XVII: XVIII: XIX: XX: XXIV (Oct., 1928).

A considerable portion of the area of Plumas County lies in the high mountains, and deposits of the metals, especially gold and copper, are found there. Mineral production for 1928 was valued at $3,599,127, the decrease being due to copper and silver. This placed the county ninth in rank. In 1919 Plumas passed Shasta in the copper lead, owing to the Shasta smelters being closed down, which position Plumas still retains.

Among its mineral resources are chromite, copper, gold, granite, iron, lead, limestone, manganese, molybdenum, platinum, silver, and zinc.

Commercial production for 1928 was as follows:

Substance	*Amount*	*Value*
Copper	21,141,121 lbs.	$3,044,321
Gold	---------	332,634
Silver	326,725 fine oz.	191,134
Stone, miscellaneous	---------	28,124
Other minerals *	---------	2,914
Total value		$3,599,127

* Includes granite, lead, manganese.

RIVERSIDE

Land area: 7240 square miles.
Population: 60,297 (1920 census).
Location: Southern portion of state.
County seat: Riverside.
References: State Mineralogist Report XV: XVII: XVIII: XX.

Riverside is the fourth county in the state in size and the sixth in regard to the total value of mineral output for 1928. Within its borders are included mountain, desert, and agricultural land. Its mineral resources include metals, structural and industrial materials, and salines, some of the more important being brick, clay, coal, copper, feldspar, gold, gypsum, iron, lead, limestone, manganese, magnesite,

marble, mineral paint, mineral water, salt, soapstone, silver, miscellaneous stone, and tin. In point of variety, Riverside County showed nineteen different minerals commercially produced in 1928. The decrease in 1928 from the 1927 output valued at $6,543,369 was due to brick and miscellaneous stone.

Commercial production for 1928 was as follows:

Substance	*Amount*	*Value*
Brick and hollow building tile	------	$499,612
Clay (pottery)	115,538 tons	543,671
Copper	13,263 lbs.	1,910
Gold	------	2,180
Lead	99,097 lbs.	5,747
Silica (quartz)	7,804 tons	27,632
Silver	2,672 fine oz.	1,563
Stone, miscellaneous	------	557,504
Other minerals *	------	4,635,082
Total value		$6,274,901

* Includes cement, feldspar, granite, gypsum, limestone, manganese, mineral water, slate, tin.

SACRAMENTO

Land area: 983 square miles.
Population: 90,978 (1920 census).
Location: North-central portion of state.
County seat: Sacramento.
References: State Mineralogist Report XV: XVII: XVIII: XX: XXI (Jan., 1925).

Sacramento stands sixteenth among the counties of the state as a mineral producer, the output, principally gold, for 1928 being valued at $2,389,645, as compared with the 1927 production worth $2,348,916.

In regard to gold output alone, this county ranks fourth, being exceeded only by Yuba, Nevada and Amador counties, the Sacramento product coming from the dredges. Its mineral resources include brick, clay, gold, granite, natural gas, platinum, silver, and miscellaneous stone.

Commercial production for 1928 was as follows:

Substance	*Amount*	*Value*
Brick and hollow building tile	----	$295,669
Gold	----	1,558,173
Granite	9,829 cu. ft.	19,658
Silver	3,041 fine oz.	1,779
Stone, miscellaneous	----	453,775
Other minerals *	----	60,591
Total value		$2,389,645

* Includes clay (pottery), natural gas, platinum.

SAN BENITO

Land area: 1392 square miles.
Population: 8995 (1920 census).
Location: West-central portion of state.
County seat: Hollister.
References: State Mineralogist Report XV: XVII: XVIII: XX: XXII (April, 1926).

While twenty-first among the counties of the state in regard to value of total mineral production for 1928, San Benito has led for some years

in one important branch of the mineral industry, namely, quicksilver. Cement is also an important item.

Its other mineral resources, many of them undeveloped, include antimony, asbestos, bituminous rock, chromite, coal, dolomite, gems, gypsum, limestone, magnesite, mineral water, and miscellaneous stone.

Commercial production for 1928 was as follows:

Substance	*Amount*	*Value*
Quicksilver	3,800 flasks	$452,345
Other minerals *	----	1,202,373
Total value		$1,654,718

* Includes cement, magnesite, mineral water, pyrite, miscellaneous stone.

SAN BERNARDINO

Land area: 20,157 square miles.
Population: 73,401 (1920 census).
Location: Southeastern portion of state.
County seat: San Bernardino.
References: State Mineralogist Report XV: XVII: XVIII: XIX: XX.

San Bernardino, by far the largest county in the state in area, ranks fifth as regards the value of its mineral output for 1928, with a total of $14,157,381, as compared with the 1927 total of $16,140,703. The decrease is mainly due to cement, in spite of decreases in gold and silver.

San Bernardino for several years (except 1918) has led all other counties in the state in point of variety of minerals, producing commercially during 1928 a total of 21 different substances. This county also ranks first as a silver producer in the state, from the mines of the Randsburg district.

This county, consisting largely of mountain and desert country, is highly mineralized, the following being included among its resources: Asbestos, barytes, borax, brick, cement, clay, copper, gems, gold, granite, gypsum, iron, lead, limestone, manganese, marble, mineral paint, mineral water, nitre, potash salt, soapstone, soda, miscellaneous stone, strontium, talc, tungsten, vanadium, and zinc.

Commercial production for 1928 was as follows:

Substance	*Amount*	*Value*
Cement	4,383,383 bbls.	$7,137,606
Clay (pottery)	2,190 tons	12,215
Copper	106,351 lbs.	15,314
Gold	----	91,717
Lead	38,097 lbs.	2,209
Lime	14,015 tons	106,312
Limestone	11,201 tons	40,224
Salt	42,244 tons	186,470
Silver	620,070 fine oz.	362,741
Stone, miscellaneous	----	329,541
Other minerals *	----	5,873,033
Total value		$14,157,381

* Includes antimony, borates, calcium chloride, fuller's earth, gems (agate and topaz), mineral water, potash, soda, talc and tungsten.

SAN DIEGO

Land area: 4221 square miles.
Population: 112,248 (1920 census).
Location: Extreme southwest corner of state.
County seat: San Diego.
References: State Mineralogist Report XIV: XVII: XVIII: XIX: XX: XXI (July, 1925).

San Diego ranks twentieth in the total value of its mineral output for the year, with 17 different commercial minerals. The value for 1928 equaled $1,770,253, as compared with the 1927 output worth $1,619,431.

In the production of semiprecious gems, San Diego County has led the state. Aside from minerals commercially produced, as shown below, San Diego County contains occurrences of bismuth, lithia, marble, nickel, soapstone, and tin. Potash has been produced from kelp.

Commercial production for 1928 was as follows:

Substance	*Amount*		*Value*
Brick and hollow building tile	-----		$101,515
Clay (pottery)	33,396	tons	63,898
Feldspar	12,836	tons	82,255
Fuller's earth	5,488	tons	47,740
Gems	-----		1,700
Gold	-----		2,671
Granite	11,836	cu. ft.	41,499
Mineral water	71,845	gals.	3,592
Silver	22	fine oz.	13
Stone, miscellaneous	-----		1,284,741
Other minerals *	-----		140,629
Total value			$1,770,253

* Includes bromine, lithia, manganese salts, salt, silica.

SAN FRANCISCO

Land area: 46½ square miles.
Population: 506,676 (1920 census).
County seat: San Francisco.
References: State Mineralogist Report XVII, XVIII, XX, XXV (April, 1929).

Surprising as it may appear at first glance, San Francisco County is listed among the mineral producing sections of the state, actual production consisting mainly of crushed rock, sand and gravel. Small quantities of various valuable mineral substances are found here, including cinnabar, gypsum, lignite, and magnesite, none, however, in paying quantities. Some pumice has been produced.

In fiftieth place, commercial production for 1928 was as follows:

Substance	*Value*
Stone, miscellaneous	$67,430

SAN JOAQUIN

Land area: 1448 square miles.
Population: 79,905 (1920 census).
Location: Central portion of state.
County seat: Stockton.
References: State Mineralogist Report XIV: XVII: XVIII: XXI (April, 1925).

San Joaquin County reported a mineral production for the year 1928 having a total value of $624,931 as compared with the 1927 output worth $711,965.

Comparatively few mineral substances are found here, the chief ones being brick, clay, manganese, natural gas, glass-sand, and miscellaneous stone. Gold, platinum and silver have been obtained by dredging in the Mokelumne River, which forms the boundary between this county and Amador on the northeast.

In twenty-seventh place, commercial production for 1928 was as follows:

Substance	*Value*
Brick and hollow building tile	$512,425
Stone, miscellaneous	63,444
Unapportioned	49,062
Total value	$624,931

SAN LUIS OBISPO

Land area: 3334 square miles.
Population: 21,893 (1920 census).
Location: Bordered by Kern County on the east and the Pacific Ocean on the west.
County seat: San Luis Obispo.
References: State Mineralogist Report XV: XVII: XVIII: XXI (Oct., 1925).

The total value of the mineral production of San Luis Obispo County in 1928 was $217,125, as compared with the 1927 output worth $295,030.

Among its mineral resources, both developed and undeveloped, are asphalt, bituminous rock, brick, chromite, coal, copper, diatomaceous earth, gypsum, iron, limestone, marble, mineral water, onyx, petroleum, quicksilver, soda and miscellaneous stone.

In forty-fourth place, commercial production for 1928 was as follows:

Substance	*Amount*	*Value*
Gold	-----	$725
Petroleum	15,140 bbls.	12,869
Quicksilver	435 flasks	48,254
Silver	2 fine oz.	1
Stone, miscellaneous	-----	111,181
Other minerals *	-----	44,095
Total value		$217,125

* Includes brick and hollow building tile, chromite, mineral water.

SAN MATEO

Land area: 447 square miles..
Population: 36,781 (1920 census).
Location: Peninsula, adjoined by San Francisco on the north.
County seat: Redwood City.
References: State Mineralogist Report XVII: XVIII: XXV (April, 1929).

San Mateo's most important mineral products are cement, stone and salt, the last named being derived by evaporation from the waters of San Francisco Bay. The total value of all mineral production during 1928 equaled $3,328,573, as compared with the 1927 figures of $1,863,838, the increase being due to cement and miscellaneous stone.

Small amounts of barytes, chromite, infusorial earth, and quicksilver have been noted in addition to the items of economic value given below. Bricks have also been produced commercially.

In tenth place, commercial production for 1928 was as follows:

Substance	*Value*
Stone, miscellaneous	$251,602
Other minerals *	3,076,971
Total value	$3,328,573

* Includes cement, limestone, magnesium salts, natural gas, petroleum, salt.

SANTA BARBARA

Land area: 2740 square miles.
Population: 41,097 (1920 census).
Location: Southwestern portion of state, adjoining San Luis Obispo on the south.
County seat: Santa Barbara.
References: State Mineralogist Report XV: XVII: XVIII: XIX: XXI (Oct., 1925).

Santa Barbara County owes its position of seventh in the state in regard to its mineral output to the presence of productive oil fields within its boundaries. The total value of its mineral production during the year 1928 was $4,577,650, as compared with the 1927 output of $2,699,296, and included ten different mineral substances. The increase was due to petroleum and diatomaceous earth.

Aside from the mineral substances listed below, Santa Barbara County contains asphalt, gilsonite, gypsum, magnesite, and quicksilver in more or less abundance.

Commercial production for 1928 was as follows:

Substance	*Amount*	*Value*
Mineral water	2,950 gals.	$175
Natural gas	1,154,803 M cu. ft.	158,930
Petroleum	3,078,103 bbls.	3,409,923
Stone, miscellaneous	--------	270,661
Other minerals *	--------	737,961
Total value		$4,577,650

* Includes barytes, bituminous rock, brick and hollow building tile, diatomaceous earth and marble.

SANTA CLARA

Land area: 1328 square miles.
Population: 100,588 (1920 census).
Location: West-central portion of state.
County seat: San José.
References: State Mineralogist Report XVII: XVIII: XX.

Santa Clara County reported a mineral output for 1928 of $1,021,541, as compared with the 1927 figures of $990,876.

This county, lying largely in the Coast Range Mountains, contains a wide variety of mineral substances, including brick, chromite, clay, limestone, magnesite, manganese, mineral water, petroleum, quicksilver, soapstone, and miscellaneous stone.

In twenty-third place, commercial production for 1928 was as follows:

Substance	*Amount*	*Value*
Brick	14,622 M	$157,732
Clay (pottery)	3,058 tons	2,063
Petroleum	13,746 bbls.	15,121
Stone, miscellaneous	-----	467,555
Other minerals *	-----	379,070
Total value		$1,021,541

* Includes limestone, magnesite, mineral water, quicksilver.

SANTA CRUZ

Land area: 435 square miles.
Population: 26,269 (1920 census).
Location: Bordering Pacific Ocean, just south of San Mateo County.
County seat: Santa Cruz.
References: State Mineralogist Report XVII: XVIII: XXII (Jan., 1926).

The mineral output of Santa Cruz County, a portion of which is itemized below, amounted to a total value of $3,323,920, giving the county a standing of eleventh among all others in the state in this regard. This is a slight decrease from the 1927 figure of $3,473,209.

Commercial production for 1928 was as follows:

Substance	*Amount*	*Value*
Lime	12,129 tons	$135,991
Limestone	8,600 tons	24,849
Stone, miscellaneous	-----	62,571
Other minerals *	-----	3,100,509
Total value		$3,323,920

* Includes bituminous rock and cement.

SHASTA

Land area: 3858 square miles.
Population: 13,311 (1920 census).
Location: North-central portion of state.
County seat: Redding.
References: State Mineralogist Report XIV: XVII: XVIII: XIX: XXII (April, 1926).

Shasta County stood twenty-second in California among the mineral producing counties for 1928, with an output valued at $1,104,729, as compared with the 1927 production worth $1,950,088, the decrease being due chiefly to zinc.

The marked decrease since 1918 is due to the falling off in the output of copper, the large plants of the Mammoth and Mountain copper companies being shut down. Not taking petroleum into account, Shasta for a number of years led all of the counties by a wide margin, but in 1919–1923 was passed by San Bernardino, Plumas, Yuba, Inyo, Sacramento, Nevada, and Amador, among the 'metal' counties, though by only San Bernardino and Plumas of that group in 1925.

Shasta's mineral resources include asbestos, barytes, brick, chromite, coal, copper, gold, iron, lead, lime, limestone, mineral water, molybdenum, pyrites, silver, soapstone, miscellaneous stone, and zinc.

Lassen Peak is located in southeastern Shasta County.

Commercial production for 1928 was as follows:

Substance	*Amount*	*Value*
Copper	3,049,910 lbs.	$439,194
Gold	--------	113,132
Lead	4,400 lbs.	255
Silver	67,403 fine oz.	39,431
Stone, miscellaneous	--------	137,034
Other minerals *	--------	385,683
Total value		$1,114,729

* Includes chromite, coal, diatomaceous earth, platinum, pyrite.

SIERRA

Land area: 923 square miles.
Population: 1783 (1920 census).
Location: Eastern border of state just north of Nevada County.
County seat: Downieville.
References: State Mineralogist Report XVI: XVII: XVIII: XX: XXV (April, 1929).

Sierra County reported a mineral production of $679,925, mainly of gold and silver, during the year 1928, as compared with the 1927 output worth $752,533. Considering gold output this county stands fifth; and as to total mineral yield twenty-fourth.

Aside from the metals itemized below, Sierra County contains deposits of asbestos, chromite, copper, iron, lead, platinum, serpentine, and talc.

Commercial production for 1928 was as follows:

Substance	*Amount*	*Value*
Gold	----	$674,855
Silver	6,174 fine oz.	3,614
Stone, miscellaneous	----	1,433
Other mineral	----	24
Total value		679,925

SISKIYOU

Land area: 6256 square miles.
Population: 18,545 (1920 census).
Location: Extreme north-central portion of state, next to Oregon boundary.
County seat: Yreka.
References: State Mineralogist Report XIV: XVII: XVIII: XIX: XX: XXI (Oct., 1925).

Siskiyou, fifth county in California in regard to size, located in a highly mineralized and mountainous country, ranks thirty-second in regard to the value of its mineral output for 1928.

Although this county is traversed by a transcontinental railroad in a north and south line, the mineral-bearing sections are almost without exception far from transportation and other facilities. A large part of the county is accessible by trail only. Future development and exploitation will increase the productiveness of this part of the state to a considerable extent.

Mount Shasta is located in Siskiyou County.

Among Siskiyou's mineral resources are chromite, clay, coal, copper, gems, gold, lead, limestone, manganese, marble, mineral water, pumice, quicksilver, sandstone, silver, and miscellaneous stone.

Commercial production for 1928 was as follows:

Substance	*Amount*	*Value*
Gold	----	$85,717
Sandstone	3,800 cu. ft.	3,800
Silver	719 fine oz.	421
Stone, miscellaneous	----	367,033
Other minerals *	----	14,195
Total value		$471,166

* Includes copper, gems (rhodonite), lead and mineral water.

SOLANO

Land area: 822 square miles.
Population: 40,602 (1920 census).
Location: Touching San Francisco Bay on the northeast.
County seat: Fairfield.
References: State Mineralogist Report XIV: XVII: XVIII: XXIII (April, 1927).

Solano, while mostly valley land, produced mineral substances during the year 1928 to the total value of $57,451, ranking fifty-first among the counties of the state, the decrease from the 1927 figures of $1,557,840 being due to cement.

Among her mineral resources are brick, cement, clay, fuller's earth, limestone, mineral water, natural gas, onyx, quicksilver, salt and miscellaneous stone.

Commercial production for 1928 was as follows:

Substance	*Value*
Unapportioned *	$57,451

* Includes mineral water, onyx, travertine, miscellaneous stone.

SONOMA

Land area: 1577 square miles.
Population: 51,990 (1920 census).
Location: South of Mendocino County, bordering on the Pacific Ocean.
County Seat: Santa Rosa.
References: State Mineralogist Report XIV: XVII: XVIII: XXII (July, 1926).

Sonoma ranked forty-sixth among the counties of California during the year 1928, with a mineral production of $212,568, as compared with its 1927 output of $265,392. More paving blocks have been turned out here than in any other section of the state, but this industry has now ceased, owing to the construction of smooth-surface pavements both in the cities and on the highways.

Among Sonoma's mineral resources are brick, chromite, clay, copper, graphite, infusorial earth, magnesite, manganese, marble, mineral paint, mineral water, quicksilver, and miscellaneous stone.

Commercial production for 1928 was as follows:

Substance	*Amount*	*Value*
Mineral water	32,720 gals.	$9,126
Sandstone	15,700 cu. ft.	6,250
Stone, miscellaneous	-----	111,429
Other minerals *	-----	85,763
Total value		$212,568

* Includes chromite, gems, quicksilver.

STANISLAUS

Land area: 1450 square miles.
Population: 43,557 (1920 census).
Location: Center of state, bounded on south by Merced County.
County seat: Modesto.
References: State Mineralogist Report XIV: XVII: XVIII: XXI (April, 1925).

Gold has usually been the chief mineral product of Stanislaus County, but it was exceeded in 1918–1919 by manganese, and in 1921–1923 and 1925–1928 by miscellaneous stone. Brick, clay, gypsum, mineral paint, quicksilver, and silver are found here to some extent as well. This county for 1928 ranks thirty-first in the state in regard to value of minerals, with an output of $472,158, as compared with $393,089 in 1927, the increase being due mainly to gold. Gold, platinum and silver are obtained mainly by dredging.

Commercial production for 1928 was as follows:

Substance	*Amount*	*Value*
Gold	---	$195,683
Silver	950 fine oz.	556
Stone, miscellaneous	---	238,067
Other minerals *	---	37,852
Total value		$472,158

* Includes magnesite, mineral paint, platinum.

SUTTER

Land area: 608 square miles.
Population: 10,115 (1920 census).
Location: Bounded by Butte County on the north and Sacramento on the south.
County seat: Yuba City.
References: State Mineralogist Report XV: XVII: XVIII.

Sutter is one of only two counties in the state which for a number of years reported no commercial output of some kind of mineral substance. In 1917 some crushed rock was taken out, from the Marysville Buttes, also in 1925–1926. There has been some utilization of natural gas. The 1928 mineral yield was valued at $2,000, being concealed under 'unapportioned.' Both clay and coal exist here, but deposits of neither mineral have been placed on a productive basis.

TEHAMA

Land area: 2893 square miles.
Population: 12,882 (1920 census).
Location: North-central portion of the state, bounded on the north by Shasta.
County seat: Red Bluff.
References: State Mineralogist Report XV: XVII: XVIII: XIX: XXIV (July, 1928).

Tehama stands fifty-sixth among the mineral producing counties of the state for 1928, when its output was valued at $14,389, as compared with the 1927 yield, worth $5,350.

Among its mineral resources are listed brick, chromite, copper, gold, manganese, marble, mineral water, salt, and miscellaneous stone.

The 1928 yield was distributed as follows:

Substance	*Value*
Stone, miscellaneous	$11,945
Unapportioned	2,444
Total value	$14,389

TRINITY

Land area: 3166 square miles.
Population: 2551 (1920 census).
Location: Northwestern portion of state.
County seat: Weaverville.
References: State Mineralogist Report XIV: XVII: XVIII: XIX: XX: XXII (Jan., 1926).

Trinity, like its neighbor, Siskiyou County, requires transportation facilities to further the development of its many and varied mineral resources. Deposits of asbestos, barytes, chromite, copper, gold, mineral water, platinum, quicksilver, silver, and building stone are known here, but with the exception of gold, chromite, copper, quicksilver and platinum, very little active production of these mineral substances has been made as yet. The 1928 output of $530,180 shows a decrease from the 1927 figure of $555,854 due to gold, giving the county rank of twenty-ninth for the year.

Commercial production for 1928 was as follows:

Substance	*Amount*	*Value*
Copper	660,142 lbs.	$95,060
Gold	------	402,694
Silver	20,954 fine oz.	12,258
Stone, miscellaneous	------	12,084
Other minerals *	------	8,084
Total value		$530,180

* Includes chromite and platinum.

TULARE

Land area: 4856 square miles.
Population: 59,031 (1920 census).
Location: Bounded by Inyo on the east, Kern on the south, Fresno on the north.
County seat: Visalia.
References: State Mineralogist Report XV: XVII: XVIII: XX.

Tulare stands thirty-fourth on the list of mineral producing counties, the decrease from the 1927 value being due mainly to magnesite.

This county's mineral resources, among others, are brick, clay, copper, feldspar, graphite, gems, limestone, magnesite, marble, quartz, glass-sand, soapstone, miscellaneous stone, and zinc. Tulare for a number of years led the state in magnesite output, except in 1918 when it was passed by Napa County, and since 1921 by Santa Clara.

Commercial production for 1928 was as follows:

Substance	*Value*
Stone, miscellaneous	$108,419
Other minerals *	336,947
Total value	$445,366

* Includes brick, gems, granite, lime, limestone, magnesite.

TUOLUMNE

Land area: 2190 square miles.
Population: 7768 (1920 census).
Location: East-central portion of state—Mother Lode District.
County seat: Sonora.
References: State Mineralogist Report XIV: XVII: XVIII: XIX: XX: XXIV (Jan., 1928).

Tuolumne ranks thirty-sixth among counties of the state relative to its total value of mineral output for 1928. This county ranks first as a producer of marble in the state. The decrease in the year's valuation to $367,278 for 1928 from the 1927 figures of $432,446 was due mainly to limestone, and partly to gold and stone.

Chromite, clay, copper, gold, lead, limestone, marble, mineral paint, platinum, soapstone, silver, and miscellaneous stone are among its mineral resources.

Commercial production for 1928 was as follows:

Substance	*Amount*	*Value*
Gold	---	$36,807
Silver	316 fine oz.	185
Stone, miscellaneous	---	9,090
Other minerals *	---	330,196
Total value		$376,278

* Includes dolomite, lime, limestone, marble, pumice, slate.

VENTURA

Land area: 1878 square miles.
Population: 28,724 (1920 census).
Location: Southwestern portion of state, bordering on Pacific Ocean.
County seat: Ventura.
References: State Mineralogist Report XV: XVII: XVIII: XX: XXI (April, 1925).

Ventura is the fourth county in the state in respect to the value of its mineral production for 1928, the exact figure being $31,116,675, as compared with the output for 1926 worth $30,995,379, the increase being due to petroleum.

Commercial production for 1928 was as follows:

Substance	*Amount*	*Value*
Clay (pottery and oil well mudding)	238,914 tons	$238,910
Natural gas	67,058,513 M cu. ft.	6,196,549
Petroleum	22,143,318 bbls.	24,311,149
Stone, miscellaneous	---	332,195
Other minerals *	---	37,872
Total value		$31,116,675

* Includes brick and building tile and granite.

YOLO

Land area: 1017 square miles.
Population: 17,105 (1920 census).
Location: Sacramento Valley, bounded by Sutter on the east and Colusa on the north.
County seat: Woodland.
References: State Mineralogist Report XIV: XVII: XVIII.

The mineral production from Yolo County during the year 1928 consisted entirely of miscellaneous stone, valued at $17,200, ranking it in fifty-fifth place. Deposits of undetermined value of iron and sandstone have been discovered within the confines of this county. Quicksilver has also been produced.

YUBA

Land area: 639 square miles.
Population: 10,375 (1920 census).
Location: Lies west of Sierra and Nevada counties; south of Plumas.
County seat: Marysville.
References: State Mineralogist Report XV: XVII: XVIII: XX.

Yuba is fourteenth of the mineral producing counties of the state, and first in regard to gold output for 1925–1928, having passed Nevada and Amador counties in that metal. Iron and clay deposits have been reported in this county aside from the following commercial production shown for the year 1928. The decrease over the 1927 figures of $3,679,632 was due mainly to gold obtained by the dredgers, which also yield silver and platinum. The 1921 dredge yield of gold was a record for the county.

The 1928 production of Yuba County was distributed as follows:

Substance	*Amount*	*Value*
Gold	----	$2,304,377
Silver	8,394 fine oz.	4,910
Stone, miscellaneous	----	202,708
Other minerals	----	17,081
Total value		$2,529,076

APPENDIX A

DIRECTORY OF PRODUCERS OF METALLIC AND NON-METALLIC MINERALS IN CALIFORNIA, 1928

NOTE.—The producers of natural gas and petroleum will be found in Summary of Operations, California Oil Fields, for August, 1928 (Vol. 14, No. 2). This list also excludes producers of gold and silver. Gold and silver figures are received by the State Division of Mines direct from the U. S. Bureau of Mines.

ANTIMONY

	Address	Mine
Kern County		
J. L. Foisie	Johannesberg	Johannesberg
San Bernardino County		
Desert Antimony Mine, J. J. Wade	Nipton	Nipton

ASBESTOS

	Address	Mine
Lake County		
Johns-Manville	Pittsburg	Middletown

BARYTES

	Address	Mine
Mariposa County		
National Pigments Co.	Russ Bldg, San Francisco	El Portal
Yosemite Barium Co.,* R. A. Fredericks, Pres. and Mgr.	El Portal	El Portal
Santa Barbara County		
La Brea Barytes Co., Inc., E. B. Smith, Mgr.	449 Church st., Santa Maria	La Brea

*Taken over by National Pigments Co. in November.

BITUMINOUS ROCK

	Address	Quarry
Santa Barbara County		
Higgins Quarry, A. Satler, lessee	Carpinteria	Carpinteria
Santa Cruz County		
Bitumen Mines Operation, John De Bruynkops	701 Post St., San Francisco	Gordola
I. W. Moore	Care Box 433, Santa Cruz	Gordola

BORATES

	Address	Plant
Inyo County		
Rasor Borate Lease, C. M. Rasor	Care of Pac. Coast Borax Co., 1014 Cent. Bldg., Los Angeles	Death Valley
Kern County		
Pacific Coast Borax Co.	1014 Central Bldg., Los Angeles	Kramer
Western Borax Co.	P. O. Box 37, Muroc	Muroc
San Bernardino County		
Amer. Potash and Chemical Corp.	Trona	Trona

BROMINE

	Address	Plant
San Diego County		
California Chemical Corp.	233 Sansome St., San Francisco	San Diego

CALCIUM CHLORIDE

	Address	Plant
San Bernardino County		
California Rock Salt Co.	2465 Hunter St., Los Angeles	Amboy
Saline Products, Inc.	2000 Santa Fe Ave., Los Angeles	Amboy

CEMENT

	Office	Plant
Calaveras County		
Calaveras Cement Co.	315 Montgomery St., San Francisco	San Andreas
Contra Costa County		
Henry Cowell Lime and Cement Co.	2 Market St., San Francisco	Cowell
Kern County		
Monolith Portland Cement Co.	Bartlett Bldg., Los Angeles	Monolith
Merced County		
Yosemite Portland Cement Co.	Merced	Merced
Riverside County		
Riverside Cement Co.	800 Corporation Bldg., Los Angeles	Riverside
San Benito County		
Pacific Portland Cement Co.	Hunter-Dulin Bldg., San Francisco	San Juan
San Bernardino County		
California Portland Cement Co.	1228 Pac. Mutual Bldg., Los Angeles	Colton
Riverside Cement Co., John Treanor, Pres	800 Corporation Bldg., Los Angeles	Oro Grande
Southwestern Portland Cement Co.	Victorville	Victorville
San Mateo County		
Pacific Portland Cement Co.	111 Sutter St., San Francisco	Redwood City
Santa Cruz County		
Santa Cruz Portland Cement Co.	Crocker Bldg., San Francisco	Davenport

CHROMITE

	Address	Mine
San Luis Obispo County		
Mutual Mine, P. A. H. Arata	San Luis Obispo	Goldtree
Shasta County		
Forest Queen Mine, S. Galegas	1225 Adam Grant Bldg., San Francisco	Gibson Siding
Antone Orsini	Box 170, Redding	----------
Sonoma County		
Alix Guthrie	Hilton	Hilton
Tehama County		
S. Galegas	1225 Adam Grant Bldg., San Francisco	Red Bluff

CLAY

(Including producers of crude clay and manufacturers of brick, tile, porcelain, etc.)

	Address	Plant
Alameda County		
[a] California Faience Co.	1335 Hearst Ave., Berkeley	Berkeley
[a, c] California Pottery Co.	2265 East 12th St., Oakland	Oakland
[c] K. Carper	Livermore	Tesla
[a, b, c] N. Clark & Sons	116 Natoma St., San Francisco	Oakland
[a, b, c] Livermore Fire Brick Work and California Brick Plant		Livermore
W. S. Dickey Clay Mfg. Co.	Rialto Bldg., San Francisco	and Fabrico
[a] Electrical Porcelain Works	2416 6th St., Berkeley	Berkeley
[a] Hidecker Tile Co.	24th and Union Sts., Oakland	Oakland
[a] Kraftile Co., L. J. Layton	55 New Montgomery St., San Francisco	Niles
[c] Livermore Clay and Sand Co.	P. O. Box 521, Livermore	Tesla
[a] M. & S. Tile Co., Geo. A. Smith and J. M. Muneze	Decoto	Decoto
[a] Miller's Oakland Art Pottery	2237 E. 12th St., Oakland	Oakland
[b] Remillard Brick Co., R. C. Giroux, Secy.	332 Phelan Bldg., San Francisco	Pleasanton
[a] Technical Porcelain and China Ware Co.	420 Kains Ave., Albany, via Berkeley, Cal.	Albany
[a] Emeryville Porcelain Works, Westinghouse Elec. and Mfg. Co.	East Pittsburgh, Pa.	Emeryville
[a] Walrich Pottery	1285 Hearst Ave., Berkeley	Berkeley
[a] Woolenius Tiles and Mantels	1631 Woolsey, Berkeley	Berkeley
Amador County		
[c] M. J. Bacon	Ione	Carbondale
[c] Carlile Clay Deposits, E. E. Tremain	Buena Vista, via R. F. D. Ione	Buena Vista
[c] N. Clark & Sons	116 Natoma St., San Francisco	Ione
[c] Ione Clay Pit, W. S. Dickey Clay Mfg. Co.	604 Mission St., San Francisco	Ione
[b] Ione Fire Brick Co., J. T. Roberts, Mgr.	541 Rialto Bldg., San Francisco	Ione
[c] Ione Clay and Sand Co., Cal. Mineral Products Co.	Kohl Bldg., San Francisco	Ione
[c] Newman Clay Co., Newman Estate	Ione	Ione
Butte County		
[b] Lund Clay Plant	Oroville	Palermo
[b] Table Mtn. Clay Prod. Co., L. F. Riley, Pres. and Mgr.	706 Veatch St., Oroville	Oroville
Contra Costa County		
[a] California Art Tile Co., J. W. Hislop, Mgr.	Box 1116, Richmond	Richmond
[c] Clark Shale Deposit, N. Clark & Sons	116 Natoma St., San Francisco	Walnut Creek
[c] Mastercraft Tile and Roofing Co.	1 20th St., Richmond	San Pablo
[b] Port Costa Brick Works, C. G. Berg, Pres.	808 Sharon Bldg., San Francisco	Port Costa
[a, b] Richmond Pressed Brick Co.	Sharon Bldg., San Francisco	Richmond
[a] Standard Sanitary Mfg. Co.	Pacific Mines, F. A. Kales, Mgr., Box W	Richmond
Fresno County		
[b] Craycroft Brick Co.	Griffith-McKenzie Bldg., Fresno	Fresno
Humboldt County		
[a, b] J. D. Thompson Brick Co., J. D. Thompson, Mgr.	Box 16, Myrtle Ave., Eureka	Eureka
Imperial County		
[b] Simons Brick Co., Walter R. Simons	620 Chamber of Commerce Bldg., Los Angeles	El Centro
Inyo County		
[e] Commercial Minerals Co.	114 Sansome St., San Francisco	----------

[a] Producer of clay products.
[b] Producer of brick and hollow building tile.
[c] Producer of crude clay.
[e] Producer of filtering clay.

CLAY (Continued)

(Including producers of crude clay and manufacturers of brick, tile, porcelain, etc.)

	Address	Plant
Kern County		
[d] Alluvial Silt Co., V. E. Britton	Muroc	Muroc
[b] Bakersfield Sandstone Brick Co., Jas. Curran, Mgr.	Bakersfield	Bakersfield
[b] King Lumber Co.	1402 King St., Bakersfield	Bakersfield
[e] Muroc Clay Co., Thos. B. Leddy	723 Title Ins. Bldg., Los Angeles	Muroc
[e] The Filtrol Co.	650 S. Spring St., Los Angeles	Saltdale
Los Angeles County		
[b] Acme Brick Co.	Hillstreet Bldg., Los Angeles	Santa Monica
[a] Alhambra Kilns, Inc., E. H. Ockerman	Alhambra and Santa Monica	Alhambra
[a, b] American Refractories Co.	3232 Alosta St., Los Angeles	
[a] Angulo Tile Plant, R. F. Angulo & Sons	Reseda	Reseda
[a] Art Tile Co.	2304 E. 52d St., Los Angeles	
[a, b] Atlas Firebrick Co.*	Box 938, R. F. D. 2, Los Angeles	
[a] Batchelder-Wilson Tile Co.	2633 Artesian St., Los Angeles	
[a] J. A. Bauer Pottery Co., Inc.	415 W. Ave. 33, Los Angeles	
[a] Bay Cities Roofing Co., Inc.	1724 Stanford St., Santa Monica	Santa Monica
[a] Calco Tile Mfg. Corp.	South Gate	
[b] City Brick Co.	P. O. Box 85th and Vermont, Los Angeles	
[a] Claycroft Potteries, Fred H. Robertson	3101 San Fernando Blvd., Los Angeles	
[b] Compton Brick and Tile Co.	Olive St., Compton	
[a] H. F. Coors Co., Inc.	Ingelewood	Inglewood
[b] Davidson Brick Co.	4701 Floral Dr., Los Angeles	
[a] Empire China Co.	Burbank	
[a, b, c] Tropico, L. A. & S. M. Plants, Gladding, McBean & Co.	660 Market St., San Francisco	Tropico, Los Angeles and Santa Monica
[a] Italian Terra Cotta Co.	1149 Mission Rd., Los Angeles	
[b] K & K Brick Co., C. J. Kuback, Pres.	701 Merch. Nat. Bank Bldg., Los Angeles	
[a, c] K & M Pottery Co.	2318 E. 52d St., Los Angeles	
[b] Long Beach Brick Co., Inc., H. A. Havner, Mgr.	243 E. 7th St., Long Beach	
[b] Los Angeles Brick Co.	1078 Mission Rd., Los Angeles	
[a, c] Malibu Potteries Co.	119 N. Larchmont St., Los Angeles	
[b] Mission Brick Co.	15209 Saugus St., Van Nuys	Van Nuys
[b] National Brick Co.	5547 Alhambra Rd., Los Angeles	Alhambra
[a, b, c] Pacific Clay Products	650 Chamber of Comm. Bldg., Los Angeles	Los Angeles and Los Nietos
[b] Pomona Brick Co., Wm. McMullen, Mgr.	Pomona	Pomona
[a] Pomona Tile Co.	Pomona	Pomona
[a] Poxon China Co., C. J. Poxon	5600 Miles Ave., Huntington Park	
[a, b, c] Santa Catalina Island Co., Wm. Wrigley, Jr.	Avalon	Santa Catalina Island
[a, b] Santa Monica Brick Co.	816 W. 5th, Los Angeles	Santa Monica
[a, b] St. Louis Fire Brick and Clay, Joseph Mesmer	2464 E 9th St., Los Angeles	
[a, c] Security Roof Co.	Stanford St., Santa Monica	Santa Monica
Security Roof Co.	1120 N. La Brea St., Los Angeles	
[a, b, c] Simons Brick Co., Walter R. Simons	620 Chamber of Commerce Bldg., Los Angeles	

[a] Producer of clay products.
[b] Producer of brick and hollow building tile.
[c] Producer of crude clay.
[d] Producer of oil well drilling mud.
[e] Producer of filtering clay.
* Now Emsco Clay Co., 8661 Dorothy Ave., South Gate.

CLAY (Continued)

(Including producers of crude clay and manufacturers of brick, tile, porcelain, etc.)

	Address	Plant
Los Angeles County—Continued		
[b] Standard Brick Co.	580 Chamber of Commerce, Los Angeles	
[a, c] The Celite Co. (formerly The Featherstone Co.)	Lompoc	Covina
[b] Torrance Brick Co.	Border St., Torrance	Torrance
[a] Vernon Potteries	2300 E. 52d St., Los Angeles	Vernon
[b] Vitrefrax Company	51 Pacific Ave., Los Angeles	Vernon
[a, b, c] Western Brick Co.	586 Chamber of Commerce Bldg., Los Angeles	
Marin County		
[b] McNear Brick Co.	946 Monadnock Bldg., San Francisco	McNears
Merced County		
[a, b, c] The California Pottery Co. V.H. Martin, Mgr.	Merced	Merced
Mono County		
[c] California Quarries Corp.	1300 Quimby Bldg., Los Angeles	Laws
Monterey County		
[a, c] Monterey Mission Tile Co., H. L. Watson	Torres and 8th Sts., Carmel	Monterey
Orange County		
[c] American Fire Clay Co.	San Juan Capistrano	San Juan Capistrano
[c] El Toro Clay Co., Amer. Refractories Co.	3232 Aosta St., Los Angeles	El Toro
[c] Emsco Clay Co.	8661 Dorothy Ave., South Gate	
[c] Gladding, McBean & Co.	660 Market St., San Francisco	
[a, b, c] La Bolsa Tile Co., A. N. Griffith	Huntington Beach	Smeltzer
[a, c] Mission Clay Products Co.	Olive	Olive
[c] Pacific Clay Products	650 Chamber of Commerce Bldg., Los Angeles	
Padre Tile Co., Arthur E. Koepsel, Mgr.	Ethlen & Grote Bldg., Orange	Olive
Placer County		
[c] Clay Corp. of Cal.	Lincoln	Lincoln
[a, b, c] Gladding, McBean & Co.	5th floor, 660 Market St., San Francisco	Lincoln
[c] Lincoln Clay Products Co., M. J. Dillman, Mgr.	Lincoln	Lincoln
Riverside County		
[c] Alberhill Coal and Clay Co., Geo. C. Hill	Alberhill	Alberhill
[a, c] Casa Blanco Tile Co.	Prado	Prado
[c] Emsco Clay Co.	5701 S. Boyle Ave., Vernon	Corona
[a, b, c] Gladding, McBean & Co.	660 Market St., San Francisco	Alberhill
[b] Hancocks Brick Yard, C. P. Hancock & Son	1330 Lemon St., Riverside	Riverside
[a, b, c] Los Angeles Brick Co.	1078 Mission Rd., Los Angeles	Alberhill
[c] Pacific Clay Products	650 Chamber of Commerce Bldg., Los Angeles	
[c] H. Pate	Corona	Prado
[c] Temescal Water Co.	Temescal, via Corona	Temescal
[a, c] True Tile Co.	Corona	
Sacramento County		
[b] Cannon & Co.	Box 281, Sacramento	Ben Ali
[c] Grover Russi Clay Pit, Gladding, McBean & Co.	660 Market St., San Francisco	White Rock
[a, b] H. C. Muddox	30th and L Sts., Sacramento	
[a] Panama Pottery Co.	Box 1478, R. F. D. No. 4, 24th St. Rd., Sacramento	
[b] Sacramento Brick Co.	1400 Front St., Sacramento	
[b] Valley Brick Co.	1917 Stockton Blvd., Sacramento	
San Bernardino County		
[c] A. B. Clark	1211 Sun Finance Bldg., Los Angeles	Oro Grande

[a] Producer of clay products.
[b] Producer of brick and hollow building tile.
[c] Producer of crude clay.

CLAY (Continued)

(Including producers of crude clay and manufacturers of brick, tile, porcelain, etc.)

	Address	Plant
San Bernardino County—Cont'd.		
[e] Coen Companies, Inc., G. W. Coen	428 Story Bldg., Los Angeles	Bradford Sta.
[c] Gladding, McBean & Co.	660 Market St., San Francisco	Bryman
[a, c] Kennedy Clay Pit, John Kennedy	Daggett	Daggett
San Diego County		
[a, c] American Encaustic T. Co.	52d and Alameda Sts., Los Angeles	El Cajon
[a, b, c] Atlas Brick and Clay Co.	3533 Herbert St., San Diego	Rose Canyon
[e] Mosto Otaylite Deposit, General Petroleum Corp.	1003 Higgins Bldg., Los Angeles	Otay
[c] Gladding, McBean & Co.	660 Market St., San Francisco	Cardiff, c/o Olivenhain, S. D.
[c] Pacific Clay Products Co.	650 Chamber of Commerce Bldg., Los Angeles	Farr Station
[e] Standard Oil of Cal.	Standard Oil Bldg., San Francisco	Palm Siding
San Francisco County		
[a] Jalanivich & Olsen	2930 Baker St., San Francisco	
San Joaquin County		
[b] San Joaquin Brick Co., J. F. Stein, Secy.	33 S. El Dorado St., Stockton	Stockton
[b] Stockton Brick and Tile Co.	McKinley Ave., Stockton	Stockton
[b] Stockton Fire Brick Co., John T. Roberts, Mgr.	Stockton	Stockton
San Luis Obispo County		
[b] San Luis Brick Works, Faulstick Bros.	San Luis Obispo	San Luis Obispo
San Mateo County		
[a] West Coast Porcelain Co.	P. O. Box 46, Millbrae	Millbrae
Santa Barbara County		
[a, b] Associated Clay Products, Elmer H. Whittaker, owner	303 Ladexa St., Santa Barbara	
Santa Clara County		
[a] Garden City Pottery, Gustave Nelson	560 N. 6th St., San Jose	San Jose
[a] Handcraft Tile Co., L. W. Austin et al.	333 S. 18th St., San Jose	San Jose
[a, c] Kartschoke Clay Prod. Co.	1098 S. 3d St., San Jose	San Jose
[b] Remillard Brick Co.	332 Phelan Bldg., San Francisco	San Jose
[c] San Jose, City of, Coyote Creek Clay Beds	San Jose	San Jose
[a, b, c] San Jose Brick Co.	P. O. Box 274, San Jose	
[a] S & S Tile Co.	1881 S. First St., San Jose	
Tehama County		
[b] O'Connor Bros.	Red Bluff	Red Bluff
Tulare County		
[b] S. P. Brick and Tile Co., W. D. Trewhitt, Mgr.	1561 Pacific SW. Bldg., Fresno	Exeter
Ventura County		
[b, c] Anderson & Hardison Press Brick Co., J. C. Hardison and G. A. Anderson	Santa Paula	Santa Paula
[a, b] Peoples Lumber Co., J. M. Sharp, Mgr.	1102 Meta St., Ventura	Ventura
[c] Selby Shale Pit, Mrs. Marjorie Selby	R. F. D. 1, Box 41, Ventura	Ventura
[d] Ventura Excavating Co.	Ventura	

[a] Producer of clay products.
[b] Producer of brick and hollow building tile.
[c] Producer of crude clay.
[d] Producer of oil well drilling mud.
[e] Producer of filtering clay.

COAL

	Address	Mine
Amador County		
Buena Vista Coal Mg. Co., J. J. Marras, Supt.	Ione, c/o R. F. D.	Buena Vista
Contra Costa County		
Higgins Coal Mine, Roy Carson	Pittsburg	Mt. Diablo
Shasta County		
Mt. Shasta Coal Co., Chas. Magill, Supt.	Oak Run	Oak Run

COPPER

Names of all companies producing 10,000 pounds of copper or more during the year.

	Address	Mine
Calaveras County		
Calaveras Copper Co.	Copperopolis	Copperopolis
San Bernardino County		
Exchequer Mines Co., Lionel Brooks, Pres.	Goffs	Goffs
Plumas County		
Engels Copper Mining Co.	391 Mills Bldg., San Francisco	Indian Valley
Walker Mining Co.	Spring Garden	Spring Garden
Riverside County		
Black Eagle Mines Co.	Roosevelt Bldg., Los Angeles	Mecca
Shasta County		
Mountain Copper Co., Ltd.	112 Market St., San Francisco	Matheson
Mason Valley Mines Co.	Thompson, Nevada	Black Mine
Trinity County		
Island Copper Co., E. R. Leach	710 Easton Bldg., Oakland	Island Mtn.

DIATOMACEOUS EARTH

	Address	Quarry
Los Angeles County		
The Featherstone Co., The Celite Co.	Lompoc	Covina
Monterey County		
Buttle Properties, Inc.*	Bradley	Bradley
Calatome Co., R. B. Hoffman et al.	Monterey	Monterey
California Kieselguhr Co., Geo. C. Langley and W. I. Davis	San Miguel	Bradley
Monterey Products Co.	Monterey	Del Monte
Pacatome Co.	California and Montgomery Sts., San Francisco	Bradley
Santa Barbara County		
The Celite Co.	Lompoc	Lompoc
Shasta County		
Mt. Shasta Silica Co., M. H. Nemeyer	Weed	Bartle

* Buttle Properties, Inc., taken over in August by the Pacatome Co.

DOLOMITE

	Address	Quarry
Inyo County		
Inyo Marble Co.	406 S. Main St., Los Angeles	Keeler
Monterey County		
Sterling Ranch Dolomite, Pacific Coast Steel Co.	Rialto Bldg., San Francisco	Natividad
Tuolumne County		
U. S. Lime Products Corp.	58 Sutter St., San Francisco	Sonora

FELDSPAR

	Address	Mine
Imperial County		
Flint Silica and Spar Co.	1047-61 Richmond St., Los Angeles	
Kern County		
N. W. Sweetser	1024 Loew State Bldg., Los Angeles	Rosamond
Riverside County		
O. W. Blom	Romoland	Romoland
San Diego County		
Elder Feldspar Mine, Geo. W. Elder	799 Oak St., San Francisco	Campo
Standard Sanitary Mfg. Co., Pacific Mines, F. A. Kales, Mgr.	P. O. Box W, Richmond	Campo

FULLER'S EARTH

	Address	Pit
Kern County		
The Filtrol Co.	650 S. Spring St., Los Angeles	Bena
San Diego County		
Mosto Otaylite Deposit, General Petroleum Corp.	1003 Higgins Bldg, Los Angeles	Otay
Standard Oil Co. of Cal.	Standard Oil Bldg., San Francisco	Palm Siding

GEMS

	Address	Mine
Butte County		
Cooney Diamond Property, M. J. Cooney, Pres.	Forbestown	Cherokee
J. C. Milliron	236 N. Griffin Ave., Los Angeles	
Calaveras County		
Green Mtn. Mine, J. J. McSorley, Mgr.	Mokelumne Hill	Mokelumne Hill
J. W. Hatfield	1524 Grove St., Oakland	Mokelumne Hill
L. J. Holman	Wallace	Mokelumne Hill
Fresno County		
C. M. Carter	2332 Valdez St., Oakland	
Inyo County		
Rocky Mountain George	Beatty, Nev.	
San Bernardino County		
Franklin Heald	Fontana	Victorville
San Diego County		
Hercules Group, A. W. Pray and E. G. Logan	243 Kansas St., Escondido	
Pala Chief Mine, Frank A. Salmons, Owner	306 John D. Spreckels Bldg., San Diego	Pala
J. W. Ware	1060 6th St., San Diego	Smith Mtn.
Sonoma County		
Healdsburg Gem Mine, Chas. A. Perry	Healdsburg	
Siskiyou County		
Marcher Bros.	729 S. Grand Ave., Los Angeles	
Tulare County		
Marcher Bros	729 S. Grand Ave., Los Angeles	

GRANITE

	Address	Quarry
Alpine County		
Alpine County	Merkleeville	
Fresno County		
Academy Granite	Academy	Academy
Superior Granite Co., Inc	Clovis	Academy
Inyo County		
Bly Stone Co. (tuff)	1985 E. 16th St., Los Angeles	Round Valley
Lassen County		
Lassen County	Susanville	Susanville
Greig Quarry	Susanville	Susanville
Los Angeles County		
Guy T. Felty	1226 S. Bedford, Los Angeles	Los Angeles
Arthur Kelly	2512 W. 7th St., Los Angeles	
Madera County		
McGilvray Raymond Corp.	3 Potrero Ave., San Francisco	Raymond
McGilvray-Raymond Granite Co.*	634 Townsend St., San Francisco	Raymond
Raymond Granite Co.*	3 Potrero Ave., San Francisco	Knowls
Mariposa County		
Yosemite National Park, U. S. Bureau of Public Roads	Sheldon Bldg., San Francisco	Yosemite Park
Nevada County		
Netz Granite Quarry, Ludwig Netz	Nevada City	Nevada City
Placer County		
Alexson Granite Co.	Rocklin	Rocklin
A. Pernu Granite Quarries, Adolph Pernu	Rocklin	Rocklin
Rocklin Stone Co., H. Grindell	Rocklin	Rocklin
Union Granite Co., Mat Ruhkala	Rocklin	Rocklin
Plumas County		
Paul Sonognini	Chilcoot	Chilcoot
Riverside County		
Stroupe Granite Quarry, Emil Johnson	Val Verde	Perris
Sacramento County		
Folsom State Prison	Represa	Represa
San Diego County		
Crystal Black Quarry, John Stridsburg	Escondido	Spooks Canyon
McGilvray-Raymond Granite Co.*	634 Townsend St., San Francisco	Lakeside
Magee Quarry, Robert J. McGee	Pala	Pala
Meyer Granite Quarry, W. A. Meyer	Lakeside	Lakeside
Southern Cal. Granite Co.	3845 Imperial St., San Diego	Lakeside
Tulare County		
Bly Stone Co.	1985 E. 16th St., Los Angeles	
California Granite Co.*	Porterville	Porterville
Ventura County		
G. W. Dryden	Fillmore	Grimes Canyon

* Consolidated to the McGilvray-Raymond Corp. in November, 1928.

GYPSUM

	Address	Quarry
Imperial County		
Imperial Gypsum Quarry, Pac. Portland Cement	111 Sutter St., San Francisco	Westmoreland
Kern County		
Koehn Gypsum Plant, Chas. Koehn	Saltdale	Saltdale
Riverside County		
E. R. Nonhoff	1116 Ramona St., Corona	Corona
U. S. Gypsum Co.	1105 Edwards & Wildey Bldg., Los Angeles	Blythe

IRON ORE AND TITANIUM

	Address	Mine
Los Angeles County		
Iron Blossom Group, R. C. McInerny	1400 E 6th St., Los Angeles	Lang

LEAD

Names of all companies producing more than 10,000 pounds or more of lead during the year.

	Address	Mine
Inyo County		
American Metals, Inc.	Darwin	Darwin
Estelle Mining Co., R. C. Troeger, Gen. Mgr.	1022 Bank of Italy Bldg., Los Angeles	Keeler
Montana-Tonopah Co., M. E. Albert, Sec.	700 Steiner St., San Francisco	----------
Oversight Mine, Link, Wright & Harrison, Lessees	Keeler	Keeler
Santa Rosa Mining Co.	Tonopah, Nev.	Keeler
Slate Range Cons. Mg., Coombe & Bliss, Lessees	Trona	Slate Range
Tecopa Cons. M. Co., L. D. Godshall, Vice Pres.	Tecopa	Tecopa
Riverside County		
Black Eagle M. Co.	Roosevelt Bldg., Los Angeles	Mecca

LIME AND LIMESTONE

	Address	Quarry
El Dorado County		
[b] Diamond Springs Lime Co.	Diamond Springs	Diamond Springs
[b] El Dorado L. and Min. Co., J. H. Bell, Receiver	Shingle Springs	Shingle Springs
[b] Pac. Portland Cement Co. Cons.	111 Sutter St., San Francisco	----------
Kern County		
[a] Summit Lime Plant, Union Lime Co., Lessee	2135 Bay St., Los Angeles	Tehachapi
Los Angeles County		
[b] Torrance Lime and Fert. Co.	Torrance	Torrance
Riverside County		
[b] San Jacinto Rock Products, G. W. Green	San Jacinto	San Jacinto
San Bernardino County		
[a] Cal. Portland Cement Co.	1228 Pac. Mutual Bldg., Los Angeles	Colton
[a, b] Chas. I. Chubbuck	123 25th Ave., San Francisco	----------
Pacific Coast Talc Co.	2149 Bay St., Los Angeles	Silver Lake
[b] Victorville Lime Rock Co.	2149 Bay St., Los Angeles	Victorville
San Mateo County		
[b] Pacific Portland Cement Co.	111 Sutter St., San Francisco	San Mateo
[a] Kunze Lime Co., Charles Kunze	720 Cypress St., San Carlos	----------
Santa Clara County		
[b] Bay Shell Co.	519 California St., San Francisco	Alviso
Santa Cruz County		
[a] Henry Cowell L. and Cement Co., W. H. George, Mgr.	2 Market St., San Francisco	Santa Cruz
[a] Holmes Lime and Cement Co.	Rialto Bldg., 116 New Montgomery St., San Francisco	----------
[b] Pacific Limestone Prod. Co.	Spring St., Santa Cruz	----------
[b] Santa Cruz Port. Cement Co.	Crocker Bldg., San Francisco	Davenport
Tulare County		
[a] Abramson & Bode Corp.	Lindsay	Lindsay
[b] Kaweah Quarries, A. C. Root, Owner	Lemon Cove	Lemon Cove
Tuolumne County		
[a, b] S. Lime Products Corp.	8 Sutter St., San Francisco	----------

[a] Producer of burnt lime.
[b] Producer of limestone.

LITHIA

	Address	Mine
San Diego County		
Stewart Lithia Mine, National Industry Chemical Corp.	Pala	Pala

MAGNESITE

	Address	Mine
San Benito County		
Sampson Magnesite Co.	803 Balford Bldg., San Francisco	Sampson Park
Santa Clara County		
Western Magnesite Mine, C. S. Maltby, Lessee	1006 Humboldt Bank Bldg., San Francisco	Red Mountain
Stanislaus County		
Red Mountain Magnesite Co.	906 First National Bank Bldg., San Francisco	Red Mountain
Tulare County		
Sierra Magnesite Co.	233 Sansome St., San Francisco	Porterville

MANGANESE

	Address	Mine
Riverside County		
Blue Chief Mine, C. M. Langdon	Blythe	----------

MAGNESIUM CHLORIDE

	Address	Plant
San Diego County		
California Chemical Corp.	233 Sansome St., San Francisco	----------
San Mateo County		
Marine Chemical Co., R. E. Clarke	South San Francisco	----------
California Chemical Corp.	233 Sansome St., San Francisco	----------

MARBLE (Including Onyx and Travertine)

	Address	Quarry
Alameda County		
Gallegas Quarry, W. S. McLean	1919 San Bruno Ave., San Francisco	Mission San Jose
Mono County		
Dinneen Marble Works	40th and Grove Sts., Oakland	Bridgeport
Santa Barbara County		
G. Antolini	111 E. Gutierrez St., Santa Barbara	Tijiguas
Bly Stone Co.	1985 E. 16th St., Los Angeles	----------
Solano County		
P. Grassi & Co.	1945 San Bruno Ave., San Francisco	Tolenas Spr.
Tolenas Springs Onyx, L. Cardini	121 14th St., San Francisco	Tolenas Spr.
Tolenas Onyx Co.	209 Mississippi St., San Francisco	Tolenas Spr.
Tuolumne County		
The Columbia Marble Co., R. H. Van Norden, Secy.	413 Rialto Bldg., San Francisco	Columbia

MINERAL PAINT

	Address	Mine
Placer County		
J. L. Williams	Auburn	Auburn
Stanislaus County		
V. J. Winkler	Knights Ferry	Knights Ferry

MINERAL WATER

	Address	Spring
Butte County		
Polk Springs, Wm. Polk, Mgr.	Chico	Chico
Richardson Springs, Lee Richardson, Mgr.	Chico	Chico
Calaveras County		
Mok-Hill Mineral Spring, Zumwalt-Dahl-Zumwalt	Mokelumne Hill	Mokelumne Hill
Contra Costa County		
Alhambra Spring, L. M. Lasell	Martinez	----------
Fresno County		
Mercey Mineral Springs Co., F. J. Bourn, Pres.	Los Banos	Los Banos
Lake County		
Adams Mineral Springs, Clarence Prather	Adams, via Middletown	Adams
Bartlett Spring Co.	163 Turk St., San Francisco	----------
Norman Mineral Springs, H. C. Norman, Mgr.	Middletown	Middletown
Witter Springs, Inc., J. A. Carroll, Pres.	62d and La Salle Sts., Chicago, Ill.	Witter Springs
Los Angeles County		
Cascade Water Co.	4556 York Blvd., Los Angeles	----------
Holly Springs Water Co.	2284 Holly Dr., Los Angeles	----------
Magnetic Spring Water Co.	936 Palm Ave., Sherman	----------
Mission Spring Water Co.	8938 Keith, Hollywood	----------
Mountain Spring Water Co.	226 S. Avenue 54, Los Angeles	----------
Rose Springs-California Spring Water Co.	4835 Pasadena Ave., Los Angeles	----------
Sparklett Bottled Water Co.	4500 York Blvd., Los Angeles	----------
Marin County		
Tamalpais Natural Mineral Water Springs, Borello Bros.	San Rafael	----------
Napa County		
G. Musante	Calistoga	Calistoga
Napa Soda Springs Co., G. H. T. Jackson	1142 Mission St., San Francisco	----------
Napa Vichy Springs, John Lepori	Napa	----------
Samuels Soda Springs, R. J. Little	Monticello	----------
Placer County		
Kilago Water, Kilago Co.	Lincoln	Valley
Riverside County		
Beulah Springs, Oscar C. McNicholl	Arlington	Arlington
San Benito County		
San Benito Min. Spring Co., E. J. Anderson	Box 632, Hollister	----------
San Bernardino County		
Arrowhead Hot Springs Co.	Washington St. and Compton Ave., Los Angeles	Arrowhead
San Diego County		
Buckman Springs	3984 Idaho St., San Diego	----------
El Granito Spr. Bottling Co.	472 10th St., San Diego	El Cajon
Rock Springs Co., E. S. Walck	Escondido	Escondido
San Luis Obispo County		
Mary Hill Mineral Well Co., Fred Merckel	Paso Robles	Paso Robles
Santa Barbara County		
Veronica Springs Co.	699 Brannan St., San Francisco	----------
Santa Clara County		
San Jose Water Co., Mr. C. Wood	397 N. 2d St., San Jose	----------

MINERAL WATER—Continued

	Address	Spring
Siskiyou County		
Shasta Water Co., J. H. Harbour, Secy.	6th and Brannan Sts., San Francisco	Dunsmuir
Yreka Bottling Works, Fred J. Meamber, Prop.	Yreka	Little Shasta
Solano County		
Blue Rock Min. Water Co., Manuel Madrid	Vallejo	Vallejo
Sonoma County		
Agua Caliente Springs Co., T. H. Corcoran, Prop.	Agua Caliente	Agua Caliente
Boyes Springs Bottling Work, F. W. Peterson, Mgr.	Boyes Springs	Boyes Springs
Barcal Springs, John Kolling	Preston	Preston
Fetters Mineral Springs, George Fetters	Fetters Springs	Fetters Springs

PLATINUM

	Address	Mine
Calaveras County		
Borden Dredge, F. J. Estep, Supt.	Jenny Lind	Calaveras River
Sacramento County		
Natomas Company of California	Natoma Division, Forum Bldg., Sacramento	Natoma
Shasta County		
Mike Malone	Platina	Beegum Creek
Stanislaus County		
La Grange Gold Dr. Co., John Barker, Mgr.	La Grange	La Grange
Trinity County		
Jacobs Hydraulic Mine, Gilzeau Bros.	Junction City	Junction City
Yuba County		
Yuba Cons. Goldfields Co.	Hammonton	Hammonton

POTASH

	Address	Plant
San Bernardino County		
American Potash and Chemical Co.	Trona	Trona

PUMICE OR VOLCANIC ASH

	Address	Quarry
Fresno County		
Earlonite Mining Co., E. P. Todd	P. O. Box 474, Selma	----------
Fort Miller Pumicite, A. H. McKenzie	Griffith-McKenzie Bldg., Fresno	Friant
Imperial County		
Brand & Stevens, Ltd., A. W. Brand	820 N. Michigan Blvd., Chicago, Ill.	Calipatria
Inyo County		
Chas. Brown	Shoshone	----------
R. W. Glendinning	837 Jackson St., Los Angeles	----------
Kern County		
Cudahy Packing Co.	803 Macy St., Los Angeles	Ceneda
Mono County		
California Quarries Corp.	1300 Quinby Bldg., Los Angeles	Laws
Tuolumne County		
Linda Products and Refining	201 N. California St., Stockton	----------

PYRITE

	Address	Mine
Alameda County		
Leona Chemical Co., D. A. McDonnell	Syndicate Bldg., Oakland	Leona Heights
San Benito County		
Antelope Copper Mining Co., H. V. Underwood	Hollister	Antelope District
Shasta County		
Mountain Copper Co., Wm. F. Kett, Mgr.	112 Market St., San Francisco	Matheson

QUICKSILVER

	Address	Mine
Fresno County		
Archer Quicksilver Mine, Joseph Byles & Sons	Coalinga	
Lake County		
Big Chief Q. Mine, Linville Bros.	Middletown	Anderson Spr.
Helen Mine, H. W. Gould	Mills Bldg., San Francisco	Middletown
Mirabel Mine, H. C. Davey, Lessee	Middletown	Middletown
Sulphur Bank Mine, F. W. Bradley	Crocker Bldg., San Francisco	Lower Lake
Napa County		
Hastings Quicksilver Mine, H. L. Slosson	333 Kearny St., San Francisco	
James Creek Placer, Ah Lee	Aetna Springs	
Knoxville Q. Mine, Geo. E. Gamble	Monticello	Knoxville
La Joya Mine, Acme Mining and Milling Co.	381 Bush St., San Francisco	Oakville
Oat Hill Mine, Norman B. Livermore	85 2d St., San Francisco	Oat Hill
Orange County		
F. B. Browning	Tustin	Tustin
C. L. McWaters	601 S. Orange Ave., Santa Ana	Red Hill
San Benito County		
Alpine Mine, Harry B. Leonard	San Benito	Hernandez
Mexican Mine, V. Gleason	Hernandez	Hernandez
New Idria Quicksilver Mines, Inc.	408 Merchants Exchange Bldg., San Francisco	Idria
Stayton Quicksilver Mine, R. B. Knox	Hollister	Hollister
San Luis Obispo County		
Deer Trail Mine, J. W. Addams	Creston	
Klau Mine, Ellard W. Carson	San Luis Obispo	Adelaide
Oceanic Mine, H. W. Gould	Mills Bldg., San Francisco	Cambria
Santa Clara County		
North Almaden Mine	Silver Creek	Silver Creek
New Almadan Mine, E. T. Haun, Lessee	655 S. 6th St., San Jose	Almadan
Sonoma County		
Buckeye Mine, C. Baumeister	Cloverdale	Cloverdale
Cloverdale Mine, Cavagnaro & Schor, Lessees	Cloverdale	Cloverdale

SALT

	Address	Plant
Alameda County		
Arden Salt Co.	Newark	Newark and Mt. Eden
California et al. Plants, Leslie California Salt Co.	Alexander Bldg., San Francisco	
Oliver Salt Co.	Mt. Eden	Mt. Eden
Inyo County		
Sierra Salt Co.	553 Chamber of Commerce Bldg., Los Angeles	Saline Valley
Kern County		
Consolidated Salt Co.	P. O. Box 28, Long Beach	Saltdale
Long Beach Salt Co.	P. O. Box 28, Long Beach	Toby
Los Angeles County		
Long Beach Salt Co.	P. O. Box 28, Long Beach	Long Beach
Modoc County		
Surprise Valley Salt Works, Joshua H. Hutchinson	Box 43, Lake City	
Mono County		
Wallis D. McPherson	Mono Lake	Mono Lake
Monterey County		
Monterey Bay Salt Co., E. C. Vierra, Mgr.	Moss Landing	Moss Landing
San Bernardino County		
California Rock-Salt Co.	2465 Hunter St., Los Angeles	Amboy
Saline Products, Inc.	2000 Santa Fe Ave., Los Angeles	Amboy
San Diego County		
Western Salt Co.	917 J. D. Spreckels Bldg., San Diego	San Diego
San Mateo County		
Leslie Salt Plant, Leslie-California Salt Co.	Alexander Bldg., San Francisco	Leslie

SANDSTONE

	Address	Quarry
Los Angeles County		
Guy T. Felty	1226 S. Bedford, Los Angeles	
Monterey County		
Carmel Stone Quarries, Arthur H. Anthony	2752 Filbert St., San Francisco	Carmel
Surra Quarry, Harry Rogers	San Carlos and 7th, Carmel	Carmel
Napa County		
H. F. Galbeath	2134 Center St., Berkeley	
Sonoma County		
S. Cabrol	Glen Ellen	Glen Ellen
Gerberding Quarry, J. S. Taylor, Lessee	124 Stanford St., Santa Rosa	Glen Ellen

SILICA

	Address	Quarry
El Dorado County		
Snow Silica Deposit, Spickey Polish Corp., Owners	1401 3d St., San Francisco	Placerville
Imperial County		
Flint Silica and Spar Co.	1047-61 Richmond St., Los Angeles	----------
Mariposa County		
James H. Helm	Le Grand	White Rock
J. M. Wood	P. O. Box 174, Le Grand	----------
Riverside County		
American Encaustic T. Co.	52d and S. Alameda Sts., Los Angeles	Murrieta
O. W. Blom Co.	Ethenac	Romcland
P. J. Weisel	La Habra	Corona
San Diego County		
Langer Silica Mine, Oscar Langer	Escondido	----------

SILLIMANITE—ANDALUSITE—CYANITE GROUP

	Address	Mine
Imperial County		
Vitrefrax Co.	5000 Pacific St., Vernon, Los Angeles	Ogilby
Mono County		
Champion Porcelain Co., Dr. J. A. Jeffery, Pres.	Butler Ave. and Grand Trunk R. R., Detroit, Mich.	Mocalno

SLATE

	Address	Quarry
El Dorado County		
Commercial Mineral Prod. Co.	114 Sansome St., San Francisco	Placerville
Pacific Minerals, Inc.	332 10th St., Richmond	Chili Bar
Riverside County		
Riverside Quarries	100 E. Colorado St., Pasadena	Perris
Tuolumne County		
Witney Slate Quarry, W. S. McLean	1919 San Bruno Ave., San Francisco	Hetch Hetchy

SOAPSTONE AND TALC

	Address	Mine
Butte County		
[a] W. H. King	Pulga	Pulga
[a] McLean Talc Deposit, W. S. McLean	1919 San Bruno Ave., San Francisco	McLean Spur
Calaveras County		
[a] Commercial Minerals Co.	114 Sansome St., San Francisco	----------
El Dorado County		
[a] Bruton Talc Mine	1607 16th St., Sacramento	Diamond Spr.
[a] Commercial Minerals Co.	114 Sansome St., San Francisco	----------
[a] Russi Soapstone Co., A. W. Prouty	Shingle Springs	----------
Inyo County		
[b] American-Italian Talc Co., S. W. Pipin, Pres.	1407 E. 6th St., Los Angeles	----------
[b] Sierra Talc Co., Franklin Booth, Mgr.	401 Equitable Bank Bldg., Los Angeles	Keeler
[b] Western Talc and Magnesite Co., R. W. Glendinning, Gen. Mgr.	1901 E. Slauson Ave., Los Angeles	Death Valley
San Bernardino County		
[b] Pacific Coast Talc Co.	2149 Bay St., Los Angeles	Silver Lake

[a] Soapstone.
[b] Talc.

SODA

	Address	Plant
Inyo County		
Clark Chemical Co., Inc.	Bartlett	Bartlett
Inyo Chemical Co.	Cartago	Cartago
Kuhnert Syndicate, Geo. White	1209 Pacific Mutual Bldg., Los Angeles	----------
Natural Soda Products Co., W. W. Waterson	Bishop	Keeler
San Bernardino County		
West End Chemical Co.	West End	Searles Lake

STONE, MISCELLANEOUS

Under the heading of stone, miscellaneous, there are four divisons—crushed rock, grinding mill pebbles, paving blocks, and sand and gravel.

Crushed rock includes all crushed rock that is used in macadam, ballast and for concrete; also rock used for rubble and rip rap.

	Address	Pit or Quarry
Alameda County		
[a, b] Alameda County	Oakland	----------
[a] Associated Gravel Co.	704 Market St., San Francisco	----------
[a] California Rock Co.	Mills Bldg., San Francisco	Pleasanton
[b] Canyon Gravel Co.	Niles	Niles
[b] Leona Quarry and Central Construction Co., Heyland Quarry	Bank Savings Bldg., Oakland	Oakland
[a] Coast Rock and Gravel Co.	1000 Hunter-Dulin Bldg., San Francisco	Niles and Eliot
[a] G & M Gravel Co., Builders Exchange Bldg.	Oakland	Pleasanton
[a] Hanifen Trucking Co.	Pleasanton	Pleasanton
[b] Kemper Bros.	Hayward	Hayward
[b] R. P. King	San Lorenzo	San Lorenzo
[c] Langdon Molding Sand, Langdon Bros.	R.F.D. Box 89, Niles	Decoto
[d] Red Shale Quarry, W. S. McLean	1919 San Bruno Ave., San Francisco	Arroyo Mocho
[b] Mtn. View Cemetery Assn.	Oakland	Piedmont
[b] Oakland Paving Co., F. W. Bilger	5000 Broadway, Oakland	----------
[b] Ramos Quarry, Ramos Bros.	C and 7th Sts., Hayward	Hayward
[a] Rhodes Jamieson & Co., G. G. Jamieson, Gen. Mgr.	Park and Blanding, Oakland	Eliot
[b] Russell Bros. Quarry, B. and L. Russell	1192 Russell Way, Hayward	Hayward
Alpine County		
[b] Alpine County	Markleeville	----------
Amador County		
[b] Pacific Gas and Elec. Co., Eng. Dept., Mr. Peterson	Market St., San Francisco	Salt Springs
Butte County		
[a, b] Butte County	Oroville	----------
[b] Bechter-Kaiser Co., R. J. Kennedy, Mgr.	Oroville	Oroville
[a, b] Coast Rock and Gravel Co.	1000 Hunter-Dulin Bldg., San Francisco	Oroville
[a, b] J. E. Johnston Rock Co.	Chico	Chico
Calaveras County		
[b] Calaveras County	San Andreas	----------
[b] Pardee Dam, East Bay Mun. Utility Dist.	1924 Broadway, Oakland	Pardee Dam
[d] Pacific Minerals, Inc.	337 10th St., Richmond	Angels
Colusa County		
[a] Colusa County	Colusa	----------
Contra Costa County		
[a] Antioch Sand Co.	312 Loew Bldg., San Francisco	Antioch
[b] Blake Bros. Co., Anson S. Blake	705 Balboa Bldg., San Francisco	----------
[b] Central Construction Co., Mr. C. D. Bates, Mgr.	O. Bank Savings Bldg., Oakland	Stege
[a] Coburn Sand Plant, C. W. Coburn, Jr.	900 O'Farrell St., San Francisco	San Francisco
[c] Columbia Steel Co.	Pittsburg	Pittsburg
[b] Brooks Island Quarry, Healy, Tibbitts Const. Co., Mr. Chas. C. Horton, Pres.	64 Pine St., San Francisco	Brooks Island
[a] Oak Point Sand Pit, Jacob Bonslett	Antioch	Antioch
[a] Oak Point Sand Co., Robert P. Easley	Antioch	Antioch
[b] Richmond Quarry and Stege Quarry, Hutchinson Co.	1706 Broadway, Oakland	Richmond and Stege

[a] Producer of sand and gravel.
[b] Producer of crushed rock (macadam, ballast, rubble, rip rap, etc.).
[c] Producer of molding sand.
[d] Producer of granules for roofing, terrazzo.

STONE, MISCELLANEOUS—Continued

	Address	Pit or Quarry
Del Norte County		
[a, b] Del Norte County	Crescent City	
[b] Webber Construction Co., H. Webber	Crescent City	
El Dorado County		
[b] Diamond Springs Lime Co.	Diamond Springs	Diamond Springs
[b] Morgan Rock Quarry, D. E. Douglas, Supt.	Georgetown	Georgetown
Fresno County		
[b] Piedra Rock Quarry, Coast Rock and Gravel Co.	1000 Hunter-Dulin Bldg., San Francisco	Piedra
[a] Grant Rock and Gravel Co.	Box 958, Fresno	Friant
[a] Service Rock Co.	T. W. Patterson Bldg., Fresno	El Prado
[b] Southern California Edison Co.	Edison Bldg., Los Angeles	
Glenn County		
[a] Southern Pacific R. R. Co., Asst. Chief Engineer	Southern Pacific Bldg., San Francisco	
[a] Stony Creek Gravel Co., H. S. Tweed	Willows	Wyo
Humboldt County		
[a] Humboldt County	Eureka	
[a, b] W. C. Elsemore	332 W. Washington St., Eureka	
[b] Engelhart Pav. and Constr. Co.	Foot of S St., Eureka	Arcata
[a] Mr. Ferguson	Arcata, R. F. D.	Arcata
[a] Street Superintendent, Fortuna	Fortuna	Fortuna
[b] Kern Construction Co., A. D. Kern	Trinidad	Trinidad
[a] Mercer Fraser Co.	2d and Commercial Sts., Eureka	Essex and Fernbridge
Imperial County		
[a] Golden State Mg. and Mar. Co.	329 Granger Block, San Diego	Dixieland
[b] Imperial Irrigation Dist., Gen. Supt. River Div.	Andrade	Andrade
[a] Imperial Rock Corp.	P. O. Box 6, Niland	Niland
[a] S. E. Layman	Holtville	Holtville
[b] Potholes Granite Quarry, U. S. Bureau of Reclamation	Winterhaven, c/o Yuma, Ariz.	
So. Cal. Marble Quarry, Columbia Cement Co.	National City Bank Bldg., Los Angeles	Coyote Wells
Kern County		
[b] Kern County	Bakersfield	
[a, b] Bakersfield Rock and Gravel Co.	Box 395, Station A, Bakersfield	
Lake County		
[a] Lake County	Lakeport	
Lassen County		
[b] County Rock Crusher	Susanville	
[a] Nevada-Cal.-Oregon R. R.	Alturas	
Los Angeles County		
[a] Associated Rock Co.	1000 N. La Brea St., Los Angeles	
[a] A., T. & S. F. R. R., I. L. Hibbard, Gen. Mgr.	609 Kerchkoff Bldg., Los Angeles	
[a] Bengal & Sons	N. Santa Anita St., Pasadena	
[a, b] Blue Diamond Co.	1650 S. Alameda St., Los Angeles	
[d] Breslin Greenstone Quarry, Gene Breslin	Little Rock	Harold
[a, b] Builders Crushed Rock Co.	Azusa	Azusa
[b] Burdick Minerals Corp, F. F. Burdick	Hermosa Beach	Hermosa Beach
[b] Concrete Materials Corp., F. M. McAvoy	P. O. Box 758, North Hollywood	
[a, b] Consumers Rock and Gravel Co.	2600 S. Alameda St., Los Angeles	

[a] Producer of sand and gravel.
[b] Producer of crushed rock (macadam, ballast, rubble, rip rap, etc.).

STONE, MISCELLANEOUS—Continued

	Address	Pit or Quarry
Los Angeles County—Continued		
[a] Cooperative Building Material Co.	6009 Santa Monica St., Los Angeles	
[a, b] Eaton Canyon Rock and Sand Co.	423 Pac. Southwest Bank Bldg.,	Pasadena
[a, b] Verdugo Canyon Plant, Gordon-Harrison-Russell, Inc.	155 E. Jefferson St., Los Angeles	Montrose
[b] Catalina Island Quarry & Graham Sand Pit, Graham Bros.	Long Beach	Catalina Isl.
[a] C. B. Hallingworth	359 7th St., San Pedro	
[a] Lankershim Sand and Gravel Co.	P. O. Box 1, Lankershim	Lankershim
[a, b] Livingston Rock and Gravel Co.	Valley Blvd. and Garfield Ave., Alhambra	San Gabrial Canyon
[a, b] Rock and Gravel Plants, Los Angeles City Engineer's Office	Los Angeles	Los Angeles
[b] Los Angeles Harbor Dept., Bureau of Maintenance	City Hall, Santa Catalina	San Pedro
[b] Los Angeles Decomposed Granite Co.	2171 W. Washington, Los Angeles	
[a] Los Angeles Rock and Gravel	Box 3439 Pasadena Ave., Los Angeles	
[a, b] Pavers Rock Co., Inc.	102 S. Central Ave., Glendale	Tujunga
[a, b] Pierson & Son	R. F. D 1, Box 426 Monrovia	Monrovia
[a, b] Preston Rock Quarry, R. K. Atwood, Sec. and Treas.	Box 194, Pasadena	La Manda Park
[a] Rancho Rock Plant	11970 W. San Fernando St., Burbank	Burbank
[a] Reliance Rock Co.	1000 Hunter-Dulin Bldg., San Francisco	Azusa-Kincaid
[a] Sidebotham Sand Plants, Edwin Sidebotham & Son	Pennsylvania St., Lomita	Lomita
[a] Stine & Ellis Rock Prod. Co., W. L. Stine, Pres.	Burbank	Lankershim
[a] Stein Sand and Gravel Co., R. O. Stein	San Gabriel	
[a] Sunset Rock Products Co.	6372 Hollywood Blvd., Los Angeles	
[a, b] Union Rock Co.	656 S. Los Angeles St., Los Angeles	
[a, b] U. S. Forest Service	Ferry Bldg., San Francisco	
Madera County		
[a, b] Madera County	Madera	
[a] Coast Rock and Gravel Co.	1000 Hunter-Dulin Bldg., San Francisco	Solo
Marin County		
[a, b] Marin County	San Rafael	
[b] Daniels Con. Co.	503 Market St., San Francisco	San Rafael
[b] Hidecker Brick Co.	24th and Union Sts., Oakland	
Mariposa County		
[d] Kelm Jasper Quarry	Bagby	Bagby
[a] Yosemite National Park	Yosemite	Yosemite National Park
[a, b] U. S. Bureau of Public Roads	Sheldon Bldg., San Francisco	Yosemite National Park
Mendocino County		
[a] Mendocino County	Ukiah	
[a] John Freitas	Ukiah	Ukiah
[a] Northwestern Pacific Ry. Co., G. W. Hicks, Chief. Engineer	64 Pine St., San Francisco	South Fork
[a] Wm. Stewart	Ukiah	Ukiah
Merced County		
[a] Merced County	Merced	
[a, b] Hammatt Gravel Plant, V. M. Hammatt	Livingston	
Modoc County		
[a] Modoc County	Alturas	
[a] Nevada-Cal.-Oregon R. R.	Alturas	

[a] Producer of sand and gravel.
[b] Producer of crushed rock (macadam, ballast, rubble, rip rap, etc.).

STONE, MISCELLANEOUS—Continued

	Address	Pit or Quarry
Monterey County		
[a, c] Del Monte Properties, A. J. Gunnell	401 Crocker Bldg., San Francisco	Pacific Grove
[a] Lapis Sand Plant, Bay Development Co.	153 Berry St., San Francisco	Lapis
[a] Wm. Machado	Box 424, Carmel	Carmel
[a] Monterey Sand Co.	Monterey	Monterey
[a] Pratt Bldg. Materials Co., Chas. F. Pratt, Gen. Mgr.	Hearst Bldg., San Francisco	----------
Napa County		
[a, b] Napa County	Napa	----------
[b] Basalt Rock Co.	8th St., Napa	----------
[a] John Cassaretto	345 Berry St., San Francisco	----------
[a] Errington Quarry, Ray Errington	Napa	----------
[a] Thorsen Gravel Pit, Harry Thorsen	St. Helena	St. Helena
[a] Watt Gravel Pit, Joseph Butala	St. Helena	St. Helena
[a] Weinberger Gravel Pit, Mrs. H. E. Weinberger	St. Helena	St. Helena
Nevada County		
[b] Nevada County	Nevada City	----------
Orange County		
[a] Orange County	Santa Ana	----------
[a] W. Brady	R. F. D 2, Orange	----------
[a] California Materials Corp.*	Whittier	Whittier
[b] A. J. Jorgensen	Garden Grove	Garden Grove
[a] Lindauer Corp.	200 W. Central Ave., La Habra	La Habra
[a] Sparkes & McClellan	813 E. Center St., Anaheim	----------
[a] Swartzbaugh Sand Pit	R. F. D. 2, Box 45G, Orange	----------
[a] Union Rock Co.	656 S. Los Angeles St., Los Angeles	Fullerton and Orange
Placer County		
[a] Placer County	Auburn	Rocklin
[b] Alexson Granite Co.	Rocklin	Rocklin
[b] A. Pernu Granite Quarries, Adolph Pernu	Rocklin	Rocklin
[a] Roseville Sand Co.	Roseville	Roseville
[b] Union Granite Co., Mat Ruhkala	Rocklin	Rocklin
Plumas County		
[a] Plumas County	Quincy	----------
[b] Western Pac. R. R. Co., E. W. Mason, Gen. Supt.	Mills Bldg., San Francisco	----------
Riverside County		
[a, b] Riverside County	Riverside	----------
[d] Bly Bros. & McGillard Co.	311 Grosse Bldg., Los Angeles	Pedley
[a] Blythe Palo Verde Irrigation District	Blythe	----------
[b] Ormand Quarry, Hauser Construction Co.	Security Bldg., Long Beach	Bly Junction
[b] Langdon Schist Quarry, C. M. Langdon	Blythe	Cox
[b] Nevada-Pacific Mineral Co., Inc.	535 Rives-Strong Bldg., Los Angeles	Jurupa Station
[b] San Jacinto Rock Prod. Co., C. G. Darling, Secy.	P. O. Box 443, San Jacinto	San Jacinto
[c] Stoupe Granite Quarry, Emil Johnson	Val Verde	Perris
[a, c] P. J. Weisel, Industrial Sands	La Habra	Corona
Sacramento County		
[a] Bay Development Co., Mr. E. H. Rix, Secy.	153 Berry St., San Francisco	----------
[c] Cannon & Co.	Box 281, Sacramento	Ben Ali
[a] Capital Sand and Gravel Co.	Rt. 3, Box 100, R. F. D., 12th St. Rd., Sacramento	American River

[a] Producer of sand and gravel.
[b] Producer of crushed rock (macadam, ballast, rubble, rip rap, etc.).
[c] Producer of molding sand.
[d] Producer of granules for roofing, terrazzo.
* Consumers Rock and Gravel Co., sold in May, 1928.

STONE, MISCELLANEOUS—Continued

	Address	Pit or Quarry
Sacramento County—Continued		
[a] Construction Materials Co.	24th St. and American River, Sacramento	American River
[a, b] Fair Oaks Crusher, Coast Rock and Gravel Co.	1000 Hunter-Dulin Bldg., San Francisco	Fair Oaks
[a, b] Cutter Rock and Sand Co.	1401 39th St., Sacramento	American River
[b] Del Paso Rock and Gravel Co.	H St. Rd., Sacramento	----------
[b] Folsom State Prison	Represa	Represa
[a, b] Pratt Building Materials Co., Clarence F. Pratt, Gen. Mgr.	Hearst Bldg., San Francisco	Sacramento and Mayhew
[a] Rhodes, Jamieson & Co. G. G. Jamieson, Gen. Mgr.	Park and Blanding Sts., Oakland	----------
San Benito County		
[b] Granite Rock Co.	Drawer M, Watsonville	Logan
San Bernardino County		
[b] Calif. Portland Cement Co.	1228 Pac. Mutual Bldg., Los Angeles	Colton
[a, b] Hanawalt Bros.	La Verne	----------
[b] Los Angeles & Salt Lake R. R., Chief Engineer	Pacific Electric Bldg., Los Angeles	----------
[a] San Bernardino Rock and Gravel Co.	W. 5th St., San Bernardino	San Bernardino
[a] Triangle Rock and Gravel Co.	San Bernardino	----------
[a] Wm. Truscott	San Bernardino	----------
[b] Declez Quarry, Vezu Bros.	Wineville	Declez
San Diego County		
[a] Bulner & Murphy Rock Plant	310 4th St., San Diego	San Diego
[a] Canyon Rock Co.	3911 5th Ave., San Diego	San Diego
[a] Challet & Braulay, Paul Challet	2155 Newton St., San Diego	San Diego
[a] R. G. Chase Rock and Sand Co., R. G. Chase	Oceanside	Oceanside
[a] Cooper & Nelson	629 1st St., San Diego	San Diego
[a] Geo. Daley	4440 Boundary St., San Diego	San Diego
[a] A. W. Duquette	4465 Reed St., San Diego	San Diego
[a, b] H. G. Fenton Material Co.	13th and Imperial Ave., San Diego	San Diego
[c] F. L. Hieatt	P. O. Box 865, San Diego	San Diego
[c] R. M. Hubbard	406 W. Nutmeg St., San Diego	San Diego
[a] Mission Valley Sand and Gravel Co.	Mission Valley	Mission Valley
[f] John T. Momand	Box 381, Carlsbad	Oceanside
[a] National Sand Co., A. S. Johnson	Box 315, National City	National City
[a] Nelson & Sloan	P. O. Box 585, Chula Vista	----------
Southwest Paving Co.	Washington Bldg., Los Angeles	Oceanside
[a] Spreckels Commercial Co.	310 4th St., San Diego	----------
[c] W. A. Thompson	3521 Eugene Pl., San Diego	----------
San Francisco County		
[c] Industrial Mineral Products, W. B. Vestal, Pres.	970 7th St., San Francisco	----------
[d] Mission Quarry Co.	210 Balboa Bldg., San Francisco	----------
San Joaquin County		
[a] Santa Fe Sand and Gravel Co., W. A. Arington	P. O. Box 271, Escalon	Escalon
[a] Western Pacific R. R. Co., E. W. Mason, Gen. Supt.	Mills Bldg., San Francisco	Kerlinger
San Luis Obispo County		
[a] San Luis Obispo County	San Luis Obispo	----------
[c] Guiton Molding Sand, Harold E. Guiton	Oceano	Oceano
[b] Southern Pacific R. R. Co., Asst. Chief Engineer	Southern Pacific Bldg., San Francisco	----------
[a] Templeton Sand Plant, Granite Rock Co.	Drawer M, Watsonville	Templeton

[a] Producer of sand and gravel.
[b] Producer of crushed rock (macadam, ballast, rubble, rip rap, etc.).
[c] Producer of molding sand.
[d] Producer of granules for roofing, terrazzo.
[f] Producer of tube mill pebbles.

STONE, MISCELLANEOUS—Continued

	Address	Pit or Quarry
San Mateo County		
[b] San Mateo County	Redwood City	
[a, b] H. E. Casey Co.	3d and B Sts., San Mateo	
[a, b, e] Dalys Quarry, Market St. Ry. Co.	58 Sutter St., San Francisco	Daly
[b] Holy Cross Cemetery	Colma	Colma
[b] Ratterree Bros. Co.	400 Walbridge Blvd., San Francisco	South San Francisco
[b] Redwood Materials Co.	Redwood City	
[b] Twohy Bros. Co. and J. F. Shea Co.	525 Market St., San Francisco	
Santa Barbara County		
[a] Gates Gravel Plant, Frank H. Gates	Santa Maria	Sisquoc
[b] Midcoast Rock Co., Giovanola & West	19 E. Corrillo St., Santa Barbara	Pt. Honda
[b] Santa Cruz Island Quarry, Seaboard Stone and Cons. Co.	P. O. Box 507, San Pedro	
[a] Lompoc, P. C. Schuch, St. Supt.	Lompoc	Lompoc
[b] Veronica Stone Co.	Veronica Springs, via Santa Barbara	Veronica Spr.
Santa Clara County		
[b] County Surveyor, Santa Clara County	Hall of Records, San Jose	
[b] G. H. Anderson	Mountain View, Santa Clara County	
[a] Associated Gravel Co.	704 Market St., San Francisco	
[a] Coyote Gravel Plant, Bay Development Co.	153 Berry St., San Francisco	Coyote Creek
[a] Beasworrick Gravel Pit, Beasworrick Bros.	75 W. Howe St., San Jose	San Jose
[a] Carroll Gravel Pit, R. D. Carroll	950 S. 6th St., San Jose	San Jose
[a] W. A. Dunlap	655 S. 16th St., San Jose	San Jose
[a] A. G. Jahn	Rt. C, Box 362, San Jose	San Jose
[b] Stanford Quarry, Hutchinson Co.	1706 Broadway, Oakland	Palo Alto
[a] Jas. A. Lemieux	Box 341, Senter Rd., San Jose	San Jose
[a] Los Gatos Sand and Gravel Co.	Los Gatos	Los Gatos
[b] J. W. Lovejoy	Rt. 1, Box 88, Mountain View	
[a] Martin Bros.	1350 Alviso St., Santa Clara	Coyote Creek
[a] Montoya Gravel Pit, M. Montoya	351 Keys St., San Jose	Coyote Creek
[a] Prentiss Paving Co.	4th and Keys Sts. San Jose	San Jose
[a] Raisch Imp. Co.	32 W. San Antonio St., San Jose	Coyote Creek
[a] Ralph Richmond	910 California St., San Jose	Coyote Creek
[a] Santa Clara Gravel Co.	Campbell	Campbell
[a] City of San Jose Sandpits, City Manager	San Jose	
[b] Taaffe Construction Co.	Los Altos	Los Altos
[a] Watson Sand and Gravel Co.	Los Gatos	
Santa Cruz County		
[b] Santa Cruz County	Santa Cruz	Felton
[a] Felton Sand and Gravel Co.	Felton	Felton
[a] Geyer Gravel Plant, J. C. Geyer	Santa Cruz	
[b] Pacific Limestone Prod. Co.	Santa Cruz	Santa Cruz
Santa Cruz Port. Cement, G. R. Gay	Crocker Bldg., San Francisco	Davenport
Shasta County		
[a, b] Shasta County	Redding	
[a] Crews Gravel Pit, Phillip Crews	17 N. Pine St., Redding	Sacramento River
[a, b] Diestelhorst Gravel Plant, Chas. Diestelhorst	Redding	Redding
[b] Superintendent Lassen Volcanic National Park	Manten	Lassen Volcanic Nat'l Park
[g] Southern Pacific R. R. Co., Asst. Chief Engineer	Southern Pacific Bldg., San Francisco	
[b] U. S. Forest Service	Ferry Bldg., San Francisco	

[a] Producer of sand and gravel.
[b] Producer of crushed rock (macadam, ballast, rubble, rip rap, etc.).
[e] Producer of paving blocks.
[g] Producer of slag.

STONE, MISCELLANEOUS—Continued

	Address	Pit or Quarry
Sierra County		
[a] Sierra County	Downieville	
[b] U. S. Forest Service	Ferry Bldg., San Francisco	
Siskiyou County		
[a, b] Siskiyou County	Yreka	
[b] Hydraulic Stone and Brick Co., c/o A. F. Graham	Klamath Falls, Ore.	Hoey
[b] Kaiser Paving Co.	Oakland	
[b] Southern Pacific R. R. Co., Asst. Chief Engineer	Southern Pacific Bldg., San Francisco	
[b] U. S. Forest Service	Ferry Bldg., San Francisco	
Solano County		
[a] Solano County	Fairfield	
Sonoma County		
[a] Sonoma County	Santa Rosa	
[b] Mecham Quarry, James Addelman	Petaluma, Star Rt. 1	
[b] Cordelia Rock Quarry, E. B. and A. L. Stone Co.	Claus Spreckels Bldg., San Francisco	Thomasson
[b] Hein Bros. Basalt Rock Co., Mark Hein, Pres.	Petaluma	Petaluma
[a] Helberg Gravel Plant	Shellville	Shellville
[a] Hotchkiss Gravel Plant	Sotoyome District, via Healdsburg	
[a] Independent Gravel Co.	Forestville	Forestville
[a] Mirabel Gravel Co.	Forestville	
[b] Petaluma and Santa Rosa E. R. R., E. H. Maggard, Mgr.	Petaluma	Stony Point
[a] Sonoma Gravel Co., H. G. Burrowes	530 Mills Bldg., San Francisco	Geyserville
[b] Stony Point Quarry, W. A. Wilson	Petaluma, Star Rt.	Stony Point
Stanislaus County		
[a] Stanislaus County	Modesto	
[a] A., T. & S. F. R. R., I. L. Hibbard, Gen. Mgr.	609 Kerchhoff Bldg., Los Angeles	
[a, b] Atlas Rock Co.	903 Commercial Bank Bldg., Stockton	Orange Blossom
[a] Honeycutt & Co., H. Honeycutt	Rt. 4, Box 1626, Modesto	Modesto
[a, b] Frank B. Marks	Newman	Crows Landing
[a] Modesto Sand Pit, City of Modesto	City Hall, Modesto	Modesto
[a] Oakdale Irrigation District, M. E. Robinson, Auditor	Oakdale	
[a] Rinehart Sand Pit, Rinehart Bros.	Modesto	
[a] Scanlon Gravel Plant, J. P. Scanlon	Patterson	Crows Landing
[a] Southern Pacific R. R. Co., Asst. Chief Engineer	Southern Pacific Bldg., San Francisco	
[a] Stewart Gravel Pit, John Stewart	Crows Landing	Crows Landing
[a] Tuolumne River Gravel Pit, Service Bros.	Waterford	Waterford
Sutter County		
[a] De Witt Bros. Quarry, De Witt Bros.	Sutter City	Marysville Buttes
Tehama County		
[a] Tehama County	Red Bluff	
Trinity County		
[a] Trinity County	Weaverville	

[a] Producer of sand and gravel.
[b] Producer of crushed rock (macadam, ballast, rubble, rip rap, etc.).

STONE, MISCELLANEOUS—Continued

	Address	Pit or Quarry
Tulare County		
[a] Tulare County	Visalia	
[b] California Quarry, McGilvray Ramond Corp.	3 Potrero Ave., San Francisco	Porterville
[a, b] John R. White, Supt. Sequoia National Park	Three Rivers	
Tuolumne County		
[a] Tuolumne County	Sonora	
[b] McLean Quarry, W. S. McLean	1919 San Bruno Ave., San Francisco	Sonora
[b] Tuolumne National Marble Co., G. Bordoli	Box 513, Sonora	
Ventura County		
[a] El Rio Sand and Gravel Co.	2234 Thompson Blvd., Ventura	El Rio
[a] Santa Clara Sand and Gravel Co.	2027 E. Main St., Ventura	Ventura
[a, b] Santa Paula Rock Co.	Willard Bridge, Santa Paula	
[a] Saticoy Rock Products Co.	Saticoy	Saticoy-Ventura
[c] Ventura Velvet Molding Sand, Chas. A. Cole	1355 Church St., Ventura	Ventura
Yolo County		
[a] Yolo Gravel Co.	P. O. Box 7, Yolo	
Yuba County		
[a] Yuba River Sand Plant, Coast Rock and Gravel Co.	1000 Hunter-Dulin Bldg., San Francisco	Marysville
[a, b] Hemstreet & Bell	411 C St., Marysville	
[a] Marysville Sand Co., Inc., C. J. Hoffman, Mgr.	Marysville	
[a] Pratt Building Material Co., Clarence F. Pratt, Gen. Mgr.	Hearst Bldg., San Francisco	

[a] Producer of sand and gravel.
[b] Producer of crushed rock (macadam, ballast, rubble, rip rap, etc.).
[c] Producer of molding sand.

TIN

	Address	Mine
Riverside County		
American Tin Corp.	594 Main St., Riverside	Temescal

TUNGSTEN

	Address	Mine
Inyo County		
Round Valley Tungsten Co., Cooper Shapley	Bishop	
San Bernardino County		
Atolia Mining Co., A. V. Udell	1022 Crocker Bldg., San Francisco	Atolia

APPENDIX B.

MINING BUREAU ACT.

Chap. 679 [Stats. 1913]; amended, Chap. 280 [Stats. 1929.]

An act establishing a state mining bureau, creating the office of state mineralogist, fixing his salary and prescribing his powers and duties; providing for the employment of officers and employees of said bureau, making it the duty of persons in charge of mines, mining operations and quarries to make certain reports, providing for the investigation of mining operations, dealings and transactions and the prosecution for defrauding, swindling and cheating therein, creating a state mining bureau fund for the purpose of carrying out the provisions of this act and repealing an act entitled "An act to provide for the establishment, maintenance, and support of a bureau, to be known as the state mining bureau, and for the appointment and duties of a board of trustees, to be known as the board of trustees of the state mining bureau, who shall have the direction, management and control of said state mining bureau, and to provide for the appointment, duties, and compensation of a state mineralogist, who shall perform the duties of his office under the control, direction and supervision of the board of trustees of the state mining bureau," approved March 23, 1893, and all acts amendatory thereof and supplemental thereto or in conflict herewith.

[Approved June 16, 1913. In effect August 10, 1913.]

[Amendment approved May 14, 1929. In effect August 14, 1929.]

The people of the State of California do enact as follows:

SECTION 1. There is hereby created and established a state mining bureau. The chief officer of such bureau shall be the state mineralogist, which office is hereby created.

SEC. 2. It shall be the duty of the governor of the State of California and he is hereby empowered to appoint a citizen and resident of this state, having a practical and scientific knowledge of mining, to the office of state mineralogist. Said state mineralogist shall hold his office at the pleasure of the governor. He shall be a civil executive officer. He shall take and subscribe the same oath of office as other state officers. He shall receive for his services a salary of three hundred dollars ($300) per month, to be paid at the same time and in the same manner as the salaries of other state officers. He shall also receive his necessary traveling expenses when traveling on the business of his office. He shall give bond for the faithful performance of his duties in the sum of ten thousand dollars ($10,000), said bond to be approved by the governor of the state of California.

SEC. 3. Said state mineralogist shall employ competent geologists, field assistants, qualified specialists and office employees when necessary in the execution of his plans and operations of the bureau, and fix their compensation. The said employees shall be allowed their necessary traveling expenses when traveling on the business of said department and shall hold office at the pleasure of said state mineralogist.

SEC. 4. It shall be the duty of said state mineralogist to make, facilitate, and encourage, special studies of the mineral resources and mineral industries of the state. It shall be his duty: to collect statistics concerning the occurrence and production of the economically important minerals and the methods pursued in making their valuable constituents available for commercial use; to make a collection of typical geological and mineralogical specimens, especially those of economic and commercial importance, such collection constituting the museum of the state mining bureau; to provide a library of books, reports, drawings, bearing upon the mineral industries, and sciences of mineralogy and geology, and arts of mining and metallurgy, such library constituting the library of the state mining bureau; to make a collection of models, drawings and descriptions of the mechanical appliances used in mining and metallurgical processes; to preserve and so maintain such collections and library as to make them available for reference and examination, and open to public inspection at reasonable hours; to maintain, in effect, a bureau of information

concerning the mineral industries of this state, to consist of such collections and library, and to arrange, classify, catalogue, and index the data therein contained, in a manner to make the information availble to those desiring it; to issue from time to time such bulletins as he may deem advisable concerning the statistics and technology of the mineral industries of this state.

SEC. 5. It is hereby made the duty of the owner, lessor, lessee, agent, manager or other person in charge of each and every mine, of whatever kind or character, within the state, to forward to the state mineralogist, upon his request, at his office not later than the thirty-first day of March, in each year, a detailed report upon forms which will be furnished showing the character of the mine, the number of men then employed, the method of working such mine and the general condition thereof, the total mineral production for the past year, and such owner, lessor, lessee, agent, manager or other person in charge of any mine within the state must furnish whatever information relative to such mine as the state mineralogist may from time to time require for the proper discharge of his official duties. Any owner, lessor, lessee, agent, manager or other person in charge of each and every mine of whatever kind or character within the state, who fails to comply with the above provisions shall be deemed guilty of a misdemeanor.*

SEC. 6. The state mineralogist now performing the duties of the office of state mineralogist shall perform the duties of the office of state mineralogist as in this act provided until the appointment and qualification of his successor as in this act provided.

SEC. 7. The said state mineralogist shall take possession, charge and control of the offices now occupied and used by the board of trustees and state mineralogist and the museum, library and laboratory of the mining bureau located in San Francisco as provided for by a certain act of the legislature approved March 23, 1893, and hereafter referred to in section fourteen hereof, and shall maintain such offices, museum, library and laboratory for the purposes provided in this act.

SEC. 8. Said state mineralogist or qualified assistant shall have full power and authority at any time to enter or examine any and all mines, quarries, wells, mills, reduction works, refining works and other mineral properties or working plants in this state in order to gather data to comply with the provisions of this act.

SEC. 9. The state mineralogist shall make a biennial report to the governor on or before the fifteenth day of September next preceding the regular session of the legislature.

SEC. 10. All moneys received by the state mining bureau or any officer thereof (except such as may be paid to them by the state for disbursement) shall be receipted for by the state mineralogist or other officer authorized by him to act in his place and at least once a month accounted for by him to the state controller and paid into the state treasury to the credit of a fund which is hereby created and designated "state mining bureau fund." All moneys now in the possession of the state mining bureau or any officer thereof received from any source whatsoever, shall be immediately paid over to the state mineralogist and by him accounted for to the controller and paid into the state treasury to the credit of said fund. Said fund shall be used and is hereby appropriated for the use of said bureau in carrying out the purposes of this act.

SEC. 11. The said state mineralogist is hereby authorized and empowered to receive on behalf of this state, for the use and benefit of the state mining bureau, gifts, bequests, devises and legacies of real or other property and to use the same in accordance with the wishes of the donors, and if no instructions are given by said donors, to manage, use, and dispose of the gifts and bequests and legacies for the best interests of said state mining bureau and in such manner as he may deem proper.

SEC. 12. The state mineralogist may, whenever he deems it advisable, prepare a special collection of ores and minerals of California to be sent to or used at any world's fair or exposition in order to display the mineral wealth of the state.

SEC. 13. The state minerologist is hereby empowered to fix a price upon and to dispose of to the public, at such price, any and all publications of the state mining bureau, including reports, bulletins, maps, registers or other publications, such price shall approximate the cost of publication and distribution. Any and all sums derived from such disposition, or from gifts or bequests made, as hereinbefore provided must be accounted for by said state mineralogist and turned over to the

* Sec. 19 of the Penal Code of California provides: "Except in cases where a different punishment is prescribed by this code, every offense declared to be a misdemeanor is punishable by imprisonment in a county jail not exceeding six months, or by a fine not exceeding five hundred dollars, or by both."

state treasurer to be credited to the mining bureau fund as provided for in section ten. He is also empowered to furnish without cost to public libraries the publications of the bureau and to exchange publications with other geological surveys and scientific societies, etc.

SEC. 14. The state mineralogist provided for by this act shall be the successor in interest of the board of trustees of the state mining bureau, and the state mineralogist, under and by virtue of that certain act, entitled "An act to provide for the establishment, maintenance, and support of a bureau, to be known as the state mining bureau, and for the appointment and duties of a board of trustees, to to be known as the board of trustees of the state mining bureau, who shall have the direction, management, and control of said state mining bureau, and to provide for the appointment, duties, and compensation of a state mineralogist, who shall perform the duties of his office under the control, direction and supervision of the board of trustees of the state mining bureau," approved March 23, 1893, and all books, papers, documents, personal property, records, and property of every kind and description obtained or possessed, or held or controlled by the said board of trustees of the said state mining bureau, and the state mineralogist, and the clerks and employees thereof, under the provisions of said act of March 23, 1893, or any act supplemental thereto or amendatory thereof, shall immediately be turned over and delivered to the said state mineralogist herein provided for, who shall have charge and control thereof.

SEC. 15. That certain act entitled "An act to provide for the establishment, maintenance, and support of a bureau, to be known as the state mining bureau, and for the appointment and duties of a board of trustees, to be known as the board of trustees of the state mining bureau, and to provide for the appointment, duties and compensation of a state mineralogist, who shall perform the duties of his office under the control, direction, and supervision of the board of trustees of the state mining bureau," approved March 23, 1893, together with all acts amendatory thereof and supplemental thereto and all acts in conflict herewith are hereby repealed.

SEC. 16. For the purpose of this act and as used herein the term "mine" is hereby defined to embrace and include all mineral bearing properties of whatever kind or character whether underground, quarry, pit, well, spring or other source from which any mineral substance is or may be obtained, and the term "mineral" for the purposes of this act and whenever so used shall embrace and include any and all mineral products both metallic and nonmetallic, solid, liquid or gaseous, and mineral waters of whatever kind or character.

DEPARTMENT OF NATURAL RESOURCES ACT.

Chap. 128 [Stats. 1927]; amended, Chap. 307 [Stats. 1929.]

An act to add a new article to chapter three of title one of part three of the Political Code to be numbered article two j, embracing sections three hundred seventy-three to three hundred seventy-three i, relating to a department of natural resources.

[Approved by the Governor April 13, 1927.]

[Amendment approved May 18, 1929.]

The people of the State of California do enact as follows:

SECTION 1. The Political Code is hereby amended by adding a new article to chapter III of title I of part III thereof, to be numbered article II*f*, embracing sections 373 to 373*i* and to read as follows:

ARTICLE II*j*.

DEPARTMENT OF NATURAL RESOURCES.

373. A department of the government of the State of California to be known as the department of natural resources is hereby created. The department shall be conducted under the control of an executive officer to be known as the director of natural resources, which office is hereby created. The director shall be appointed by and hold office at the pleasure of the governor and shall receive a salary of six thousand dollars per annum.

Except as in this article otherwise provided, the provisions of article II of this chapter, title, and part of the Political Code as adopted at the forty-fourth session of the Legislature and as the same may be amended from time to time, shall govern and apply to the conduct of the department of natural resources in every respect the same as if such provisions were herein set forth at length and wherever in said article II the term "head of the department" or similar designation occurs, the same shall for the purposes of this article mean the director of natural resources.

373*a*. For purposes of administration the department shall be forthwith organized by the director thereof, subject to the approval of the governor, in such manner as he shall deem necessary to properly segregate and conduct the work of the department, and the director shall have power to appoint, in accordance with the civil service and other provisions of law, such deputies, officers and other expert and clerical assistants as may be necessary. The work of the department is hereby divided into at least four divisions to be known as the division of forestry, the division of parks, the division of fish and game, and the division of mines.

373*b*. The division of mines shall be administered through a chief who shall be appointed by the director of natural resources upon the nomination of the state mining board, the chief to be a technically trained mining engineer and to be known as the state mineralogist; such chief shall receive a salary of six thousand dollars per annum. General policies for the guidance of the division of mines shall be determined by a board to be known as the state mining board, which shall consist of five members appointed by and to hold office at the pleasure of the governor.

373*c*. The division of forestry shall be administered through a chief of division who shall be known as the state forester, who shall be a technically trained forester, appointed by the director of natural resources upon nomination by the state board of forestry hereinafter provided. General policies for the guidance of the division of forestry shall be determined by a state board of forestry which shall consist of seven members appointed by and holding office at the pleasure of the governor. Of the seven members one shall be familiar with the pine timber industry, one with the redwood industry, one with the live stock industry, one with general agriculture and one with the problems of water conservation.

373*d*. The division of parks shall be administered through a chief of division who shall be appointed by the director of natural resources upon nomination by the state park commission hereinafter provided. General policies for the administration of the state park system shall be determined by the state park commission

which is hereby created to consist of five members appointed by the governor and holding office at his pleasure.

373*e*. The division of fish and game shall be administered through a fish and game commission consisting of three members appointed by and holding office at the pleasure of the governor.

373*f*. The chiefs of the divisions of forestry and parks respectively shall receive such salaries as may be determined by the director with the approval of the governor. The director of natural resources and the chief of each devision before entering upon his duties shall execute to the State of California an official bond in the penal sum of twenty-five thousand dollars conditioned upon the faithful performance of his duties. The members of the board of forestry, the state parks commission and fish and game commission shall serve without compensation, but shall be entitled to their actual expenses incurred in the performance of their duties.

373*g*. The department of natural resources shall succeed to and is hereby invested with all the duties, powers, purposes, responsibilities and jurisdiction of the state mining bureau, state mineralogist, department of petroleum and gas, state oil and gas supervisor, state forester, state board of forestry, California redwood park commission, San Pasqual battlefield commission, Mount Diablo park commission, state fish and game commission, state fish and game commissioners, and, except as herein otherwisee provided, of the several officers, deputies and employees of such bodies and offices, and whenever by the provisions of any statute or law now in force or that may hereafter be enacted a duty or jurisdiction is imposed or authority conferred upon any of said officers, offices, bodies, deputies or employees by any statute the enforcement of which is transferred to the department, such duty, jurisdiction and authority are hereby imposed upon and transferred to the department of natural resources and the appropriate officers thereof with the same force and effect as though the title of said department of natural resources had been specifically set forth and named therein in lieu of the name of any such body, office, officer, deputy or employee. Said bodies and offices, the duties, powers, purposes, responsibilities and jurisdiction of which are so transferred and vested in the department of natural resources, and the positions of all officers, deputies and employees thereunder, are and each of them is hereby abolished and shall have no further legal existence, but the statutes and laws under which they existed and all laws prescribing their duties, powers, purposes, responsibilities and jurisdiction, together with all lawful rules and regulations established thereunder are hereby expressly continued in force.

The department of natural resources shall be in possession and control of all records, books, papers, offices, equipment, supplies, moneys, funds, appropriations, land and other property real or personal now or hereafter held for the benefit or use of said bodies, offices and officers.

The boards of district oil and gas commissioners, the offices of district oil and gas commissioners and the board of review, correction and equalization created by the act approved June 10, 1915, establishing the department of petroleum and gas, are hereby respectively continued in force wiith the powers, duties, responsibilities and jurisdiction in them vested by the provisions of said act approved June 10, 1915, as amended; *provided*, that said board of review shall consist of the director of natural resources, the director of finance and the chairman of the state board of equalization.

373*h*. The management and control of the property acquired by the State of California under or pursuant to the provisions of the act entitled "An act to accept the gift to the state of San Pasqual battlefield in San Diego county, to provide for collecting and systematizing the history of said battle, for determining the exact location thereof, and to report a suitable method of marking said battlefield and commemorating the heroism of those Americans who fought and died there," approved May 11, 1919, is hereby transferred to and vested in the department of natural resources.

373*i*. From and after the date upon which this act takes effect, the department of natural resources shall be and is hereby authorized and empowered to expend the moneys in any appropriation or in any special fund in the state treasury now remaining or made available by law for the administration of the provisions of all the statutes the administration of which is committed to the department, or for the use, support, or maintenance of any board, bureau, commission, department, office or officer whose duties, powers, and functions are, by the provisions of this article, transferred to and conferred upon the department of natural resources. Such expenditures by the department shall be made in accordance with law in carrying out the purposes for which such appropriations were made or such special funds created.

PUBLICATIONS OF THE DIVISION OF MINES

During the past forty-nine years, in carrying out the provisions of the organic act creating the former California State Mining Bureau, there have been published many reports, bulletins and maps which go to make up a library of detailed information on the mineral industry of the state, a large part of which could not be duplicated from any other source.

One feature that has added to the popularity of the publications is that many of them have been distributed without cost to the public, and even the more elaborate ones have been sold at a price which barely covers the cost of printing.

Owing to the fact that funds for the advancing of the work of this department have often been limited, many of the reports and bulletins mentioned were printed in limited editions which are now entirely exhausted.

Copies of such publications are available, however, in the office of the Division of Mines, in the Ferry Building, San Francisco; New Orpheum Building, Los Angeles; State Office Building, Sacramento; Redding; Santa Maria; Santa Paula; Coalinga; Taft; Bakersfield. They may also be found in many public, private and technical libraries in California and other states, and foreign countries.

A catalog of all publications from 1880 to 1917, giving a synopsis of their contents, is issued as Bulletin No. 77.

Publications in stock may be obtained by addressing any of the above offices and enclosing the requisite amount in the case of publications that have a list price. Only coin, stamps or money orders should be sent, and it will be appreciated if remittance is made in this manner rather than by personal check.

The prices noted include delivery charges to all parts of the United States. Money orders should be made payable to the Division of Mines.

NOTE.—The Division of Mines frequently receives requests for some of the early Reports and Bulletins now out of print, and it will be appreciated if parties having such publications and wishing to dispose of them will advise this office.

REPORTS

Asterisks (**) indicate the publication is out of print.

	Price
**First Annual Report of the State Mineralogist, 1880, 43 pp. Henry G. Hanks	----
**Second Annual Report of the State Mineralogist, 1882, 514 pp., 4 illustrations, 1 map. Henry G. Hanks	----
**Third Annual Report of the State Mineralogist, 1883, 111 pp., 21 illustrations. Henry G. Hanks	----
**Fourth Annual Report of the State Mineralogist, 1884, 410 pp., 7 illustrations. Henry G. Hanks	----
**Fifth Annual Report of the State Mineralogist, 1885, 234 pp., 15 illustrations, 1 geological map. Henry G. Hanks	----
**Sixth Annual Report of the State Mineralogist, Part I, 1886, 145 pp., 3 illustrations, 1 map. Henry G. Hanks	----
**Part II, 1887, 222 pp., 36 illustrations. William Irelan, Jr.	----
**Seventh Annual Report of the State Mineralogist, 1887, 315 pp. William Irelan, Jr.	----

REPORTS—Continued

Asterisks (**) indicate the publication is out of print.

	Price
**Eighth Annual Report of the State Mineralogist, 1888, 948 pp., 122 illustrations. William Irelan, Jr.	----
**Ninth Annual Report of the State Mineralogist, 1889, 352 pp., 57 illustrations, 2 maps. William Irelan, Jr.	----
**Tenth Annual Report of the State Mineralogist, 1890, 983 pp., 179 illustrations, 10 maps. William Irelan, Jr.	----
Eleventh Report (First Biennial) of the State Mineralogist, for the two years ending September 15, 1892, 612 pp., 73 illustrations, 4 maps. William Irelan, Jr.	$1.00
**Twelfth Report (Second Biennial) of the State Mineralogist, for the two years ending September 15, 1894, 541 pp., 101 illustrations, 5 maps. J. J. Crawford	----
**Thirteenth Report (Third Biennial) of the State Mineralogist, for the two years ending September 15, 1896, 726 pp., 93 illustrations, 1 map. J. J. Crawford	----
Chapters of the State Mineralogist's Report, Biennial Period, 1913–1914, Fletcher Hamilton:	
**Mines and Mineral Resources, Amador, Calaveras and Tuolumne Counties, 172 pp., paper	----
Mines and Mineral Resources, Colusa, Glenn, Lake, Marin, Napa, Solano, Sonoma and Yolo Counties, 208 pp., paper	.50
Mines and Mineral Resources, Del Norte, Humboldt and Mendocino Counties, 59 pp., paper	.25
**Mines and Mineral Resources, Fresno, Kern, Kings, Madera, Mariposa, Merced, San Joaquin and Stanislaus Counties, 220 pages, paper	----
Mines and Mineral Resources of Imperial and San Diego Counties, 113 pp., paper	.35
**Mines and Mineral Resources, Shasta, Siskiyou and Trinity Counties, 180 pp., paper	----
**Fourteenth Report of the State Mineralogist, for the Biennial Period 1913–1914, Fletcher Hamilton, 1915:	
A General Report on the Mines and Mineral Resources of Amador, Calaveras, Tuolumne, Colusa, Glenn, Lake, Marin, Napa, Solano, Sonoma, Yolo, Del Norte, Humboldt, Mendocino, Fresno, Kern, Kings, Madera, Mariposa, Merced, San Joaquin, Stanislaus, San Diego, Imperial, Shasta, Siskiyou and Trinity Counties, 974 pp., 275 illustrations, cloth	----
Chapters of the State Mineralogist's Report, Biennial Period, 1915–1916. Fletcher Hamilton:	
**Mines and Mineral Resources, Alpine, Inyo and Mono Counties, 176 pp., paper	----
**Mines and Mineral Resources, Butte, Lassen, Modoc, Sutter and Tehama Counties, 91 pp., paper	----
Mines and Mineral Resources, El Dorado, Placer, Sacramento and Yuba Counties, 198 pp., paper	.65
Mines and Mineral Resources, Monterey, San Benito, San Luis Obispo, Santa Barbara and Ventura Counties, 183 pp., paper	.65
Mines and Mineral Resources, Los Angeles, Orange and Riverside Counties, 136 pp., paper	.50
**Mines and Mineral Resources, San Bernardino and Tulare Counties, 186 pp., paper	----
**Fifteenth Report of the State Mineralogist, for the Biennial Period 1915–1916, Fletcher Hamilton, 1917:	
A General Report on the Mines and Mineral Resources of Alpine, Inyo, Mono, Butte, Lassen, Modoc, Sutter, Tehama, Placer, Sacramento, Yuba, Los Angeles, Orange, Riverside, San Benito, San Luis Obispo, Santa Barbara, Ventura, San Bernardino and Tulare Counties, 990 pp., 413 illustrations, cloth	----
Chapters of the State Mineralogist's Report, Biennial Period 1917–1918, Fletcher Hamilton:	
Mines and Mineral Rosources of Nevada County, 270 pp., paper	.75
Mines and Mineral Resources of Plumas County, 188 pp., paper	.50
Mines and Mineral Resources of Sierra County, 144 pp., paper	.50

REPORTS—Continued

Asterisks (**) indicate the publication is out of print.

	Price
Seventeenth Report of the State Mineralogist, 1920, 'Mining in California during 1920,' Fletcher Hamilton; 562 pp., 71 illustrations, cloth	$1.75
Eighteenth Report of the State Mineralogist, 1922, 'Mining in California,' Fletcher Hamilton. Chapters published monthly beginning with January, 1922:	
**January, **February, March, April, May, June, July, August, September, October, November, December, 1922	Free
Chapters of Nineteenth Report of the State Mineralogist, 'Mining in California,' Fletcher Hamilton and Lloyd L. Root. January, February, March, September, 1923	Free
Chapters of Twentieth Report of the State Mineralogist, 'Mining in California,' Lloyd L. Root. Published quarterly. January, April, **July, October, 1924, per copy	.25
Chapters of Twenty-first Report of the State Mineralogist, 'Mining in California,' Lloyd L. Root. Published quarterly:	
January, 1925, Mines and Mineral Resources of Sacramento, Monterey and Orange Counties	.25
April, 1925, Mines and Mineral Resources of Calaveras, Merced, San Joaquin, Stanislaus and Ventura Counties	.25
July, 1925, Mines and Mineral Resources of Del Norte, Humboldt and San Diego Counties	.25
October, 1925, Mines and Mineral Resources of Siskiyou, San Luis Obispo and Santa Barbara Counties	.25
Subscription, $1.00 in advance (by calendar year, only).	
Chapters of Twenty-second Report of the State Mineralogist, 'Mining in California,' Lloyd L. Root. Published quarterly:	
January, 1926, Mines and Mineral Resources of Trinity and Santa Cruz Counties	.25
April, 1926, Mines and Mineral Resources of Shasta, San Benito and Imperial Counties	.25
July, 1926, Mines and Mineral Resources of Marin and Sonoma Counties	.25
October, 1926, Mines and Mineral Resources of El Dorado and Inyo Counties, also report on Minaret District, Madera County	.25
Chapters of Twenty-third Report of the State Mineralogist, 'Mining in California,' Lloyd L. Root. Published quarterly:	
January, 1927, Mines and Mineral Resources of Contra Costa County; Santa Catalina Island	.25
April, 1927, Mines and Mineral Resources of Amador and Solano Counties	.25
July, 1927, Mines and Mineral Resources of Placer and Los Angeles Counties	.25
October, 1927, Mines and Mineral Resources of Mono County	.25
Chapters of Twenty-fourth Report of the State Mineralogist, 'Mining in California,' Lloyd L. Root. Published quarterly:	
January, 1928, Mines and Mineral Resources of Tuolumne County	.25
April, 1928, Mines and Mineral Resources of Mariposa County	.25
July, 1928, Mines and Mineral Resources of Butte and Tehama Counties	.25
October, 1928, Mines and Mineral Resources of Plumas and Madera Counties	.25
Chapters of Twenty-fifth Report of the State Mineralogist, 'Mining in California,' Walter W. Bradley. Published quarterly:	
January, 1929, Mines and Mineral Resources of Lassen, Modoc and Kern Counties; also on Special Placer Machines	.25
April, 1929, Mines and Mineral Resources of Sierra, Napa, San Francisco and San Mateo Counties	.25
Chapters of State Oil and Gas Supervisor's Report: Summary of Operations—California Oil Fields, July, 1918, to March, 1919 (one volume)	Free
Summary of Operations—California Oil Fields. Published monthly, beginning April, 1919:	
**April, **May, June, **July, **August, **September, **October, November, **December, 1919	Free
January, February, March, April, **May, June, July, **August, September, October, November, December, 1920	Free

REPORTS—Continued

Asterisks (**) indicate the publication is out of print

	Price
January, **February, **March, **April, May, June, **July, August, **September, **October, **November, **December, 1921	Free
January, February, March, April, May, June, July, August, September, October, November, December, 1922	Free
January, February, March, April, May, June, July, August, September, October, November, December, 1923	Free
January, February, March, April, May, June, July, August, September, October, November, December, 1924	Free
January, February, March, April, May, June, July, August, September, October, November, December, 1925	Free
January, February, March, April, May, June, July, August, September, October, November, December, 1926	Free
January, February, March, April, May, June, July, August, September, October, November, December, 1927	Free
January, February, March, April, May, June, July, 1928	Free

BULLETINS

**Bulletin No. 1. A Description of Some Desiccated Human Remains, by Winslow Anderson. 1888, 41 pp., 6 illustrations	----
**Bulletin No. 2. Methods of Mine Timbering, by W. H. Storms. 1894, 58 pp., 75 illustrations	----
**Bulletin No. 3. Gas and Petroleum Yielding Formations of Central Valley of California, by W. L. Watts. 1894, 100 pp., 13 illustrations, 4 maps	----
**Bulletin No. 4. Catalogue of Californian Fossils, by J. G. Cooper, 1894, 73 pp., 67 illustrations. (Part I was published in the Seventh Annual Report of the State Mineralogist, 1887.)	----
**Bulletin No. 5. The Cyanide Process, 1894, by Dr. A. Scheidel. 140 pp., 46 illustrations	----
Bulletin No. 6. California Gold Mill Practices, 1895, by E. B. Preston, 85 pp., 46 illustrations	$0.50
**Bulletin No. 7. Mineral Production of California, by Counties, for the year 1894, by Charles G. Yale. Tabulated sheet	----
**Bulletin No. 8. Mineral Production of California, by Counties, for the year 1895, by Charles G. Yale. Tabulated sheet	----
**Bulletin No. 9. Mine Drainage, Pumps, etc., by Hans C. Behr. 1896, 210 pp., 206 illustrations	----
**Bulletin No. 10. A bibliography Relating to the Geology, Palæontology and Mineral Resources of California, by Anthony W. Vogdes. 1896, 121 pp.	----
**Bulletin No. 11. Oil and Gas Yielding Formations of Los Angeles, Ventura and Santa Barbara Counties, by W. L. Watts. 1897, 94 pp., 6 maps, 31 illustrations	----
**Bulletin No. 12. Mineral Production of California, by Counties, for 1896, by Charles G. Yale. Tabulated sheet	----
**Bulletin No. 13. Mineral Production of California, by Counties, for 1897, by Charles G. Yale. Tabulated sheet	----
**Bulletin No. 14. Mineral Production of California, by Counties, for 1898, by Charles G. Yale	----
**Bulletin No. 15. Map of Oil City Fields, Fresno County, by John H. Means. 1899	----
**Bulletin No. 16. The Genesis of Petroleum and Asphaltum in California, by A. S. Cooper. 1899, 39 pp., 29 illustrations	----
**Bulletin No. 17. Mineral Production of California, by Counties, for 1899, by Charles G. Yale. Tabulated sheet	----
**Bulletin No. 18. Mother Lode Region of California, by W. H. Storms. 1900, 154 pp., 49 illustratinos	----
**Bulletin No. 19. Oil and Gas Yielding Formations of California, by W. L. Watts. 1900, 236 pp., 60 illustrations, 8 maps	----
**Bulletin No. 20. Synopsis of General Report of State Mining Bureau, by W. L. Watts. 1901, 21 pp. This bulletin contains a brief statement of the progress of the mineral industry in California for the four years ending December, 1899	----
**Bulletin No. 21. Mineral Production of California by Counties, by Charles G. Yale. 1900. Tabulated sheet	----

BULLETINS—Continued

Asterisks (**) indicate the publication is out of print.

	Price
**Bulletin No. 22. Mineral Production of California for Fourteen Years, by Charles G. Yale. 1900. Tabulated sheet	----
Bulletin No. 23. The Copper Resources of California, by P. C. DuBois, F. M. Anderson, J. H. Tibbits and G. A. Tweedy. 1902, 282 pp., 69 illustrations, 9 maps	$0.50
**Bulletin No. 24. The Saline Deposits of California, by G. E. Bailey. 1902, 216 pp., 99 illustrations, 5 maps	----
**Bulletin No. 25. Mineral Production of California, by Counties, for 1901, by Charles G. Yale. Tabulated sheet	----
**Bulletin No. 26. Mineral Production of California for the Past Fifteen Years, by Charles G. Yale. 1902. Tabulated sheet	----
**Bulletin No. 27. The Quicksilver Resources of California, by William Forstner. 1903, 273 pp., 144 illustrations, 8 maps	----
**Bulletin No. 28. Mineral Production of California for 1902, by Charles G. Yale. Tabulated sheet	----
**Bulletin No. 29. Mineral Production of California for Sixteen Years, by Charles G. Yale. 1903. Tabulated sheet	----
**Bulletin No. 30. Bibliography Relating to the Geology, Palæontology and Mineral Resources of California, by A. W. Vogdes. 1903, 290 pp.	----
**Bulletin No. 31. Chemical Analyses of California Petroleum, by H. N. Cooper. 1904. Tabulated sheet	----
**Bulletin No. 32. Production and Use of Petroleum in California, by Paul W. Prutzman. 1904, 230 pp., 116 illustrations, 14 maps	----
**Bulletin No. 33. Mineral Production of California, by Counties, for 1903, by Charles G. Yale. Tabulated sheet	----
**Bulletin No. 34. Mineral Production of California for Seventeen Years, by Charles G. Yale. 1904. Tabulated sheet	----
**Bulletin No. 35. Mines and Minerals of California, by Charles G. Yale. 1904, 55 pp., 20 county maps. Relief map of California	----
**Bulletin No. 36. Gold Dredging in California, by J. E. Doolittle. 1905. 120 pp., 66 illustrations, 3 maps	----
**Bulletin No. 37. Gems, Jewelers' Materials, and Ornamental Stones of California, by George F. Kunz. 1905, 168 pp., 54 illustrations	----
**Bulletin No. 38. Structural and Industrial Materials of California, by Wm. Forstner, T. C. Hopkins, C. Naramore and L. H. Eddy. 1906, 412 pp., 150 illustrations, 1 map	----
**Bulletin No. 39. Mineral Production of California, by Counties, for 1904, by Charles G. Yale. Tabulated sheet	----
**Bulletin No. 40. Mineral Production of California for Eighteen Years, by Charles G. Yale. 1905. Tabulated sheet	----
**Bulletin No. 41. Mines and Minerals of California for 1904, by Charles G. Yale. 1905, 54 pp., 20 county maps	----
**Bulletin No. 42. Mineral Production of California, by Counties, 1905, by Charles G. Yale. Tabulated sheet	----
**Bulletin No. 43. Mineral Production of California for Nineteen Years, by Charles G. Yale. Tabulated sheet	----
**Bulletin No. 44. California Mines and Minerals for 1905, by Charles G. Yale. 1907, 31 pp., 20 county maps	----
**Bulletin No. 45. Auriferous Black Sands of California, by J. A. Edman. 1907. 10 pp.	----
**Bulletin No. 46. General Index of Publications of the California State Mining Bureau, by Charles G. Yale. 1907, 54 pp.	----
**Bulletin No. 47. Mineral Production of California, by Counties, 1906, by Charles G. Yale. Tabulated sheet	----
**Bulletin No. 48. Mineral Production of California for Twenty Years, by Charles G. Yale. 1906	----
**Bulletin No. 49. Mines and Minerals of California for 1906, by Charles G. Yale. 34 pp.	----
Bulletin No. 50. The Copper Resources of California, 1908, by A. Hausmann, J. Kruttschnitt, Jr., W. E. Thorne and J. A. Edman. 366 pp., 74 illustrations. (Revised edition.)	1.00
**Bulletin No. 51. Mineral Production of California, by Counties, 1907, by D. H. Walker. Tabulated sheet	----

BULLETINS—Continued

Asterisks (**) indicate the publication is out of print.

	Price
**Bulletin No. 52. Mineral Production of California for Twenty-one Years, by D. H. Walker. 1907. Tabulated sheet	----
**Bulletin No. 53. Mineral Production of California for 1907, with County Maps, by D. H. Walker. 62 pp.	----
**Bulletin No. 54. Mineral Production of California, by Counties, by D. H. Walker, 1908. Tabulated sheet	----
**Bulletin No. 55. Mineral Production of California for Twenty-two Years, by D. H. Walker, 1908. Tabulated sheet	----
**Bulletin No. 56. Mineral Production for 1908, with County Maps and Mining Laws of California, by D. H. Walker. 78 pp.	----
**Bulletin No. 57. Gold Dredging in California, by W. B. Winston and Chas. Janin. 1910, 312 pp., 239 illustrations, 10 maps	----
**Bulletin No. 58. Mineral Production of California, by Counties, by D. H. Walker. 1909. Tabulated sheet	----
**Bulletin No. 59. Mineral Production of California for Twenty-three Years, by D. H. Walker. 1909. Tabulated sheet	----
**Bulletin No. 60. Mineral Production for 1909, with County Maps and Mining Laws of California, by D. H. Walker. 94 pp.	----
**Bulletin No. 61. Mineral Production of California, by Counties, for 1910, by D. H. Walker. Tabulated sheet	----
**Bulletin No. 62. Mineral Production of California for Twenty-four Years, by D. H. Walker. 1910. Tabulated sheet	----
**Bulletin No. 63. Petroleum in Southern California, by P. W. Prutzman. 1912, 430 pp., 41 illustrations, 6 maps	----
**Bulletin No. 64. Mineral Production for 1911, by E. S. Boalich. 49 pp.	----
**Bulletin No. 65. Mineral Production for 1912, by E. S. Boalich. 64 pp.	----
**Bulletin No. 66. Mining Laws of the United States and California. 1914, 89 pp.	----
**Bulletin No. 67. Minerals of California, by Arthur S. Eakle. 1914, 226 pp.	----
**Bulletin No. 68. Mineral Production for 1913, with County Maps and Mining Laws, by E. S. Boalich. 160 pp.	----
**Bulletin No. 69. Petroleum Industry of California, with Folio of Maps (18 by 22), by R. P. McLaughlin and C. A. Waring. 1914, 519 pp., 13 illustrations, 83 figs. [18 plates in accompanying folio.]	----
**Bulletin No. 70. Mineral Production for 1914, with County Maps and Mining Laws. 184 pp.	----
**Bulletin No. 71. Mineral Production for 1915, with County Maps and Mining Laws, by Walter W. Bradley. 193 pp., 4 illustrations	----
Bulletin No. 72. The Geologic Formations of California, by James Perrin Smith. 1916, 47 pp.	$0.25
**Reconnaissance Geologic Map (of which Bulletin 72 is explanatory), in 23 colors. Scale: 1 inch = 12 miles. Mounted	----
**Bulletin No. 73. First Annual Report of the State Oil and Gas Supervisor of California, for the Fiscal Year 1915–16, by R. P. McLaughlin. 278 pp., 26 illustrations	----
**Bulletin No. 74. Mineral Production of California in 1916, with County Maps, by Walter W. Bradley. 179 pp., 12 illustrations	----
**Bulletin No. 75. United States and California Mining Laws. 1917, 115 pp., paper	----
Bulletin No. 76. Manganese and Chromium in California, by Walter W. Bradley, Emile Huguenin, C. A. Logan, W. B. Tucker and C. A. Waring. 1918, 248 pp., 51 illustrations, 5 maps, paper	.50
Bulletin No. 77. Catalogue of Publications of California State Mining Bureau, 1880–1917, by E. S. Boalich. 44 pp., paper	Free
Bulletin No. 78. Quicksilver Resources of California, with a Section on Metallurgy and Ore-Dressing, by Walter W. Bradley, 1918, 389 pp., 77 photographs and 42 plates (colored and line cuts), cloth	1.50
Bulletin No. 79. Magnesite in California, by Walter W. Bradley. 1925, 147 pp., 62 photographs, 11 line cuts and maps, cloth	1.00
†Bulletin No. 80. Tungsten, Molybdenum and Vanadium in California. (In preparation.)	
†Bulletin No. 81. Foothill Copper Belt of California. (In preparation.)	

† Not yet published.

BULLETINS—Continued

Asterisks (**) indicate the publication is out of print.

	Price
**Bulletin No. 82. Second Annual Report of the State Oil and Gas Supervisor, for the Fiscal Year 1916–1917, by R. P. McLaughlin. 1918, 412 pp., 31 illustrations, cloth	----
Bulletin No. 83. California Mineral Production for 1917, with County Maps, by Walter W. Bradley. 179 pp., paper	Free
**Bulletin No. 84. Third Annual Report of the State Oil and Gas Supervisor, for the Fiscal Year 1917–1918, by R. P. McLaughlin. 1918, 617 pp., 28 illustrations, cloth	----
**Bulletin No. 85. Platinum and Allied Metals in California, by C. A. Logan, 1919. 10 photographs, 4 plates, 120 pp., paper	----
Bulletin No. 86. California Mineral Production for 1918, with County Maps, by Walter W. Bradley. 1919, 212 pp., paper	Free
**Bulletin No. 87. Commercial Minerals of California, with notes on their uses, distribution, properties, ores, field tests, and preparation for market, by W. O. Castello. 1920, 124 pp., paper	----
Bulletin No. 88. California Mineral Production for 1919, with County Maps, by Walter W. Bradley. 1920, 204 pp., paper	Free
**Bulletin No. 89. Petroleum Resources of California, with Special Reference to Unproved Areas, by Lawrence Vander Leck. 1921, 12 figures, 6 photographs, 6 maps in pocket, 186 pp., cloth	----
Bulletin No. 90. California Mineral Production for 1920, with County Maps, by Walter W. Bradley. 1921, 218 pp., paper	Free
Bulletin No. 91. Minerals of California, by Arthur S. Eakle. 1923, 328 pp., cloth	$1.00
Bulletin No. 92. Gold Placers of California, by Chas. S. Haley. 1923, 167 pp., 36 photographs and 7 plates (colored and line cuts, also geologic map), cloth	1.50
Extra copies of the Geologic Map (in 4 colors)	.50
Bulletin No. 93. California Mineral Production for 1922, by Walter W. Bradley. 1923, 188 pp., paper	Free
Bulletin No. 94. California Mineral Production for 1923, by Walter W. Bradley. 1924, 162 pp., paper	Free
Bulletin No. 95. Geology and Ore Deposits of the Randsburg Quadrangle, by Carlton D. Hulin. 1925, 152 pp., 49 photographs, 13 line cuts, 1 colored geologic map, cloth	2.00
**Bulletin No. 96. California Mineral Production for 1924, by Walter W. Bradley. 1925, 173 pp., paper	----
**Bulletin No. 97. California Mineral Production for 1925, by Walter W. Bradley. 1926, 172 pp., paper	----
Bulletin No. 99. Clay Resources and Ceramic Industry of California, by Waldemar Fenn Dietrich. 1928, 383 pp., 70 photos, 12 line cuts including maps, cloth	1.50
**Bulletin No. 100. California Mineral Production for 1926, by Walter W. Bradley. 1927, 174 pp., paper	----
Bulletin No. 101. California Mineral Production for 1927, by Henry H. Symons. 1928, 311 pp., paper	Free

PRELIMINARY REPORTS

**Preliminary Report No. 1. Notes on Damage by Water in California Oil Fields, December, 1913. By R. P. McLaughlin. 4 pp.	----
**Preliminary Report No. 2. Notes on Damage by Water in California Oil Fields, March, 1914. By R. P. McLaughlin. 4 pp.	----
Preliminary Report No. 3. Manganese and Chromium, 1917. By E. S. Boalich. 32 pp.	Free
**Preliminary Report No. 4. Tungsten, Molybdenum and Vanadium. By E. S. Boalich and W. O. Castello, 1918. 34 pp. Paper	----
**Preliminary Report No. 5. Antimony, Graphite, Nickel, Potash, Strontium and Tin. By E. S. Boalich and W. O. Castello, 1918. 44 pp. Paper.	----
**Preliminary Report No. 6. A Review of Mining in California During 1919. By Fletcher Hamilton, 1920. 43 pp. Paper	----
**Preliminary Report No. 7. The Clay Industry in California. By E. S. Boalich, W. O. Castello, E. Huguenin, C. A. Logan, and W. B. Tucker, 1920. 102 pp. 24 illustrations. Paper	----

PRELIMINARY REPORTS—Continued

Asterisks (**) indicate the publication is out of print.

	Price
**Preliminary Report No. 8. A Review of Mining in California During 1921, with Notes on the Outlook for 1922. By Fletcher Hamilton, 1922. 68 pp. Paper	----

MISCELLANEOUS PUBLICATIONS

**First Annual Catalogue of the State Museum of California, being the collection made by the State Mining Bureau during the year ending April 16, 1881. 350 pp.	----
**Catalogue of books, maps, lithographs, photographs, etc., in the library of the State Mining Bureau at San Francisco, May 15, 1884. 19 pp.	----
**Catalogue of the State Museum of California, Volume II, being the collection made by the State Mining Bureau from April 16, 1881, to May 5, 1884. 220 pp.	----
**Catalogue of the State Museum of California, Volume III, being the collection made by the State Mining Bureau from May 15, 1884, to March 31, 1887. 195 pp.	----
**Catalogue of the State Museum of California, Volume IV, being the collection made by the State Mining Bureau from March 30, 1887, to August 20, 1890. 261 pp.	----
**Catalogue of the Library of the California State Mining Bureau, September 1, 1892. 149 pp.	----
**Catalogue of West North American and Many Foreign Shells with Their Geographical Ranges, by J. G. Cooper. Printed for the State Mining Bureau, April, 1894	----
**Report of the Board of Trustees for the four years ending September, 1900. 15 pp. Paper.	----
Bulletin. Reconnaissance of the Colorado Desert Mining District. By Stephen Bowers, 1901. 19 pp. 2 illustrations. Paper.	Free
Commercial Mineral Notes. A monthly mimeographed sheet, beginning April, 1923	Free

MAPS

Register of Mines With Maps.

**Register of Mines, with Map, Amador County	----
**Register of Mines, with Map, Butte County	----
**Register of Mines, with Map, Calaveras County	----
**Register of Mines, with Map, El Dorado County	----
**Register of Mines, with Map, Inyo County	----
**Register of Mines, with Map, Kern County	----
**Register of Mines, with Map, Lake County	----
**Register of Mines, with Map, Mariposa County	----
**Register of Mines, with Map, Nevada County	----
**Register of Mines, with Map, Placer County	----
**Register of Mines, with Map, Plumas County	----
**Register of Mines, with Map, San Bernardino County	----
**Register of Mines, with Map, San Diego County	----
Register of Mines, with Map, Santa Barbara County (1906)	$0.25
**Register of Mines, with Map, Shasta County	----
**Register of Mines, with Map, Sierra County	----
**Register of Mines, with Map, Siskiyou County	----
**Register of Mines, with Map, Trinity County	----
**Register of Mines, with Map, Tuolumne County	----
Register of Mines, with Map, Yuba County (1905)	.25
Register of Oil Wells, with Map, Los Angeles City (1906)	.35

OTHER MAPS

**Map of California, Showing Mineral Deposits (50 x 60 in.)	----
**Map of Forest Reserves in California	----
**Mineral and Relief Map of California	----

OTHER MAPS—Continued

Asterisks (**) indicate the publication is out of print.

	Price
**Map of El Dorado County, Showing Boundaries, National Forests	----
**Map of Madera County, Showing Boundaries, National Forests	----
**Map of Placer County, Showing Boundaries, National Forests	----
**Map of Shasta County, Showing Boundaries, National Forests	----
**Map of Sierra County, Showing Boundaries, National Forests	----
**Map of Siskiyou County, Showing Boundaries, National Forests	----
**Map of Tuolumne County, Showing Boundaries, National Forests	----
**Map of Mother Lode Region	----
**Map of Desert Region of Southern California	----
Map of Minaret District, Madera County	$0.20
Map of Copper Deposits in California	.05
**Map of Calaveras County	----
**Map of Plumas County	----
**Map of Trinity County	----
**Map of Tuolumne County	----
Geological Map of Inyo County. Scale 1 inch equals 4 miles	.60
**Map of California accompanying Bulletin No. 89, showing generalized classification of land with regard to oil possibilities. Map only, without Bulletin	----
Geological Map of California, 1916. Scale 1 inch equals 12 miles. As accurate and up-to-date as available data will permit as regards topography and geography. Shows railroads, highways, post offices and other towns. First geological map that his been available since 1892, and shows geology of entire state as no other map does. Geological details lithographed in 23 colors. Unmounted	.75
Mounted	2.00
Topographic Map of Sierra Nevada Gold Belt, showing distribution of auriferous gravels, accompanying Bulletin No. 92 (also sold singly) In 4 colors	.50

OIL FIELD MAPS

These maps are revised from time to time as development work advances and ownerships change.

Map No. 1—Sargent, Santa Clara County	.50
Map No. 2—Santa Maria, including Cat Canyon and Los Alamos	.75
Map No. 3—Santa Maria, including Casmalia and Lompoc	.75
Map No. 4—Whittier-Fullerton, including Olinda, Brea Canyon, Puente Hills, East Coyote and Richfield	.75
Map No. 5—Whittier-Fullerton, including Whittier, West Coyote and Montebello	.75
Map No. 6—Salt Lake, Los Angeles County	.75
Map No. 7—Sunset and San Emidio and Kern County	.75
Map No. 8—South Midway and Buena Vista Hills, Kern County	.75
Map No. 9—North Midway and McKittrick, Kern County	.75
Map No. 10—Belridge and McKittrick, Kern County	.75
Map No. 11—Lost Hills and North Belridge, Kern County	.75
Map No. 12—Devils Den, Kern County	.75
Map No. 13—Kern River, Kern County	.75
Map No. 14—Coalinga, Fresno County	1.00
Map No. 15—Elk Hills, Kern County	.75
Map No. 16—Ventura-Ojai, Ventura County	.75
Map No. 17—Santa Paula-Sespe Oil Fields, Ventura County	.75
Map No. 18—Piru-Simi-Newhall Oil Fields	.75
Map No. 19—Arroyo Grande, San Luis Obispo County	.75
Map No. 20—Long Beach Oil Field	1.25
Map No. 21—Portion of District 4, Showing Boundaries of Oil Fields, Kern and Kings counties	.75
Map No. 21A—Portion Kern and Kings counties	.75

OIL FIELD MAPS—Continued

	Price
Map No. 22—Portion of District 3, Showing Oil Fields, Santa Barbara County	$0.75
Map No. 23—Portion of District 2, Showing Boundaries of Oil Fields, Ventura County	.75
Map No. 24—Portion of District 1, Showing Boundaries of Oil Fields, Los Angeles and Orange counties	.75
Map No. 26—Huntington Beach Oil Field	.75
Map No. 27—Santa Fe Springs Oil Field	.75
Map No. 28—Torrance, Los Angeles County	.75
Map No. 29—Dominguez, Los Angeles County	.75
Map No. 30—Rosecrans, Los Angeles County	.75
Map No. 31—Inglewood, Los Angeles County	.75
Map No. 32—Seal Beach, Los Angeles and Orange counties	.75
Map No. 33—Rincon, Ventura County	.75
Map No. 34—Mt. Poso, Kern County	.75
Map No. 35—Round Mountain, Kern County	.75
Map No. 36—Kettleman Hills, Kings County	1.25

DETERMINATION OF MINERAL SAMPLES

Samples (limited to three at one time) of any mineral found in the state may be sent to the Division of Mines for identification, and the same will be classified free of charge. No samples will be determined if received from points outside the state. It must be understood that no assays, or quantitative determinations will be made. Samples should be in lump form if possible, and marked plainly with name of sender on outside of package, etc. No samples will be received unless delivery charges are prepaid. A letter should accompany sample, giving locality where mineral was found and the nature of the information desired.

INDEX

Page

Alameda County ---- 135
Alpine County ---- 135
Aluminum ---- 42
Amador County ---- 136
Amblygonite ---- 111, 113
American Petroleum Institute, cited ---- 32
American Trust Co., cited ---- 129, 131
Andalusite ---- 119
Antimony ---- 42–43
  producer, 1928 ---- 165
  total production ---- 43
Appendix A ---- 163 193
Appendix B ---- 194
Aquamarine ---- 106
Architectural terra cotta ---- 99
Arrowhead Hot Springs, radioactivity at ---- 113, 114
Arsenic ---- 43
Art Pottery ---- 99
Asbestos ---- 96
  producers, 1928 ---- 165
  production by years ---- 96
Ash, volcanic ---- 115
Asphalt ---- 69
Averill, Chas. V. ---- 41
Bancroft, H. H., cited ---- 50
Barytes ---- 97
  producers, 1928 ---- 165
  total production ---- 97
Ballast, railroad ---- 92 93
Bauxite ---- 42
Benitoite ---- 106
Bentonite ---- 104
Beryl ---- 44, 106
Beryllium ---- 44
Bismuth ---- 44
Bisque ware ---- 99
Bituminous rock ---- 69
  producers, 1928 ---- 165
  total production ---- 70
Borates ---- 124–126
  producers, 1928 ---- 166
  production, 1864–1928 ---- 126
Bowles, O., cited ---- 86
Bradley, W. W., cited ---- 24, 26, 32, 49, 73, 87, 88, 101, 109, 114
Brick ---- 70–72
  producers, 1928 ---- 168–171
  production of various kinds ---- 71
  total production, 1893–1928 ---- 72
Bromine ---- 126
  producer, 1928 ---- 166
Brown, J. R., cited ---- 48
Building stone. (*See* Granite, Marble, Sandstone, etc.)
Bulletins, list of ---- 198–208
Bush, R. D., cited ---- 27–28
Butte County ---- 136
Cadmium ---- 44–45
Calaveras County ---- 137
Calcium chloride ---- 127
  producers, 1928 ---- 166
  use on roads ---- 127
California, area of ---- 134
Chief source of potash in United States ---- 134
  map showing approximate location of natural gas pipe lines ---- 20
  map of, showing approximate location of oil fields ---- 35
Californite ---- 106
Cameron, Walter ---- 22
Carbon dioxide gas (natural) produced ---- 23
Casing-head gas ---- 24–25
Celestite ---- 123
Cement ---- 72–74
  natural ---- 73
  producers, 1928 ---- 166
  total production ---- 74
Chalcedony ---- 106

Page
Chart, California, showing location of oil fields and districts 35
non-ferrous metals, current trend of world production 39
prices, copper, electrolytic 46
lead, common 53
silver, bar, bullion 61
zinc, slab 66
Chemical stoneware 99
Chimney pipe 99
Chinaware 99
Chromite 74–75
concentration of 75
imports of 75
occurrence of 74–75
producers, 1928 167
total production 75
Chrysoprase 106
Clay, for oil well drilling mud 99
Clay, pottery 98–100
producers, 1928 168–171
production, 1887–1928 100
products 99
uses of, other than for pottery 99
Cliché alloys 44
Coal 18–19
producer, 1928 172
total production of 19
Cobalt 45
Colemanite 125
Colloidal clay 104
Collom, R. E., cited 32
Colusa County 137
Concentration of chromite 75
Concrete, rock for 92–93
Conduit 99
Contra Costa County 138
Copper 39, 45–48
chart, trend of world production 39
electrolytic copper prices 46
producers, 1928 172
production, 1882–1928 48
stocks of, in United States 47
United States production of 47
'Cornish' or 'Cornwall' stone 99
Counties, mineral production of 16, 134
Crushed rock 91–93
producers, 1928 186, 193
Cryolite 42
Cyanite 119
Curbing 78
Del Norte County 138
Department of Natural Resources Act 197, 198
Diamonds 106
Diatomaceous earth 100, 102
producers, 1928 172
total production of 102
Directory of producers 163, 193
Dolomite 102
producers, 1928 173
total production 102
Douglas Memorial Bridge 73
Drain tile 99
Dredge production of platinum 56
Dredging, gold 50
Dudley Ridge Syndicate 22
Dumortierite 119
Economic conditions changed 12
El Dorado County 139
Electric smelting of ferro alloys 52
Elliott No. 1 26
Eng. and Min. Jour., cited 39, 44, 46, 53, 54, 58, 66
Faience tile 99
Feldspar 103–104
producers, 1928 173
total production 104
Ferberite 64
Ferro-chrome by electric furnace 52
-manganese by electric furnace 52
-silicon by electric furnace 52
Fertilizers. (*See* Gypsum, Limestone, Phosphates, Potash.)
Fire brick 71
clay 99
Flue linings 99
Fluorspar 103
Freitas, John, sand plant 92

Page
Freight, proportion of, from mines ... 92
Fresno County ... 139
Fuels ... 18–40
Fuller's earth ... 104, 105
producers, 1928 ... 173
total production ... 105
Garnets ... 105–106
Gas (*See* Natural Gas.)
Gasoline from natural gas ... 24–25
Gavin, M. J., cited ... 117
Gems ... 105–117
producers, 1928 ... 174
total production ... 107
varieties ... 106
Geysers, California, radioactivity at ... 113
Glass sand ... 118
Glenn County ... 140
Gneiss, for gems ... 106
Gold ... 48–51
production by counties, 1928 ... 48
total production ... 51
Goodyear, W. A., cited ... 19
Granite ... 76–79
producers, 1928 ... 175
production, 1887–1928 ... 79
varieties of, in California ... 76
Granules for roofing and stucco ... 92–93
Graphite ... 107–108
total production ... 108
Gravel ... 90–91
Greenstone granules ... 92–93
Grinding mill pebbles ... 89
producers, 1928 ... 190
Gypsum ... 108–109
producers, 1928 ... 176
total production ... 109
uses ... 108
Hanks, Henry, cited ... 29
Heikes, V. C., cited ... 50, 62
High-speed steels ... 65
Hittell, T. H., cited ... 50
Hollow building tile or blocks ... 70–72
Hübernite ... 65
Humboldt County ... 140
Hyacinth ... 106
Hydrargillite ... 42
Hydrated lime ... 79
Hydrocarbons ... 18
Imperial County ... 141
Industrial materials ... 95–123
Infusorial earth ... 100
Inyo County ... 141
Iridium ... 57–58
Iron ore ... 52
producer, 1928 ... 176
total production ... 52
Jade ... 106
Jewelers' materials. (*See* Gems.)
Keene's cement ... 108
Kegley, Howard C., cited ... 21–22
Kennedy Mine ... 49
Kern County ... 142
Kernite ... 124
Kieselguhr ... 100
Kings County ... 142
Knudsen, cited ... 24–25, 33
Kramer district ... 125
Kunzite ... 106
Lake County ... 143
Lassen County ... 143
Lassen Peak ... 156
Lead ... 39, 52–54
chart, prices, common ... 53
producers, 1928 ... 176
production, 1877–1928 ... 54
trend of world production ... 39
Leipidolite ... 111
Lime ... 79–80
producers, 1928 ... 177
production, 1894–1928 ... 80
Limestone ... 110
dust ... 110
producers, 1928 ... 177
production, 1894–1928 ... 110

Page
Lithia ---- 111
producers, 1928 ---- 177
Los Angeles County ---- 144
Times, cited ---- 21–22
Macadam ---- 92–93
Madera County ---- 144
Magnesite ---- 80–82
duty on ---- 82
imports of ---- 81
occurrence of ---- 80
producers, 1928 ---- 178
production districts ---- 80
production, 1887–1928 ---- 82
uses of ---- 81
Magnesium salts ---- 127–128
producers, 1928 ---- 178
Manganese ---- 54–55
imports of, from Brazil ---- 54
producers ---- 178
total production ---- 55
Map, outline of California, showing natural gas pipe lines ---- 20
outline of California, showing oil fields ---- 35
Marble ---- 83
producers, 1928 ---- 178
production, 1887–1928 ---- 83
Marin County ---- 145
Mariposa County ---- 145
Mar-John Mine, cobalt in ---- 45
Marketing, importance of, to industrial groups ---- 12
Medicinal salts ---- 132
Mendocino County ---- 146
Mercantile Trust Review, cited ---- 50
Merced County ---- 146
Metals ---- 38–67
Mica ---- 111–112
Minerals, county ---- 134–162
industry, review of ---- 11–17
output by counties ---- 16, 134
by substances ---- 14–15
output, comparative value, 1926–1928 ---- 14–15
paint ---- 112–113
producer, 1928 ---- 178
production of, California, totals by years, since 1887 ---- 113
water ---- 113–115
effect of prohibition on ---- 115
producers, 1928 ---- 179
production, 1887–1928 ---- 115
production, 1887–1928 ---- 17
total production of, by years ---- 17
variety of, produced in California ---- 14
Mining and Scientific Press, cited ---- 30
Mining Bureau Act ---- 194–196
Miscellaneous stone ---- 86–94
producers, 1928 ---- 163–193
production, 1893–1928 ---- 94
Modoc County ---- 147
Molding sand ---- 91
Molybdenum ---- 55–56
Mono County ---- 147
Monterey County ---- 147
Montmorillonite ---- 104
Monumental stone ---- 78
Morganite ---- 106
Names of producers in 1927 ---- 163–193
Napa County ---- 148
Natural gas ---- 19–25
outline map of California showing pipe lines ---- 20
pipe lines ---- 21
gasoline from ---- 24–25
production, 1888–1927 ---- 23–24
Nevada County ---- 148
Nickel ---- 56
Nitrates ---- 128–129
Nitrogen, atmospheric, fixation of ---- 128
Non-ferrous metals, world production of ---- 39
Oil. (*See* Petroleum.)
fields, map of approximate location of ---- 35
lands, proved ---- 34
shale ---- 117
well drilling mud ---- 99
Onyx ---- 83–84
Orange County ---- 149
Osmium ---- 58
Otaylite ---- 104

Page
Oxychloride cement ---- 81
Pacific Clay Products Co. gypsum plant ---- 109
Palladium ---- 58
Paraffine oils ---- 31
Paving blocks ---- 88
Peat ---- 18
Pebbles for grinding mills ---- 89
Petroleum ---- 26–37
average price by counties, 1916–1927 ---- 28
drilling and development ---- 28
features of, 1927 ---- 27–28
map of California, approximate location of oil fields ---- 35
production, 1875–1928 ---- 30
production and value by counties ---- 28
production by fields ---- 32
production of light and heavy gravities ---- 32
production statistics, 1928 ---- 36–37
proved oil land ---- 34
statistics of well operations ---- 31
storage of ---- 34
and price changes ---- 27
utilization of ---- 34
yield per day of wells ---- 31, 36–37
Phosphates ---- 115
Placer County ---- 149
Plaster and brick sand ---- 90
Platinum ---- 56–58
consumption of, by industries ---- 57
from blister copper ---- 57
prices ---- 58
producers, 1928 ---- 180
production of, 1887–1928 ---- 58
stocks ---- 58
uses, markets and consumption ---- 57–58
Plumas County ---- 150
Porcelain ---- 99
Potash ---- 129–131
California chief source of, in United States ---- 129–130
producers, 1928 ---- 180
total production of ---- 131
Pottery clays ---- 99
Proved oil land ---- 34
Publications of State Division of Mines ---- 198–208
Pumice ---- 115–116
producers, 1928 ---- 181
Pyrites ---- 116–117
producers, 1928 ---- 181
total production ---- 117
Quartz ---- 118–119
crystals ---- 105
Quicksilver ---- 58–60
imports of ---- 59
producers, 1928 ---- 182
production, 1850–1928 ---- 60
production of, in United States ---- 59
prices ---- 59
uses of ---- 59
Radioactivity of hot springs ---- 113
Red earthenware ---- 99
roofing granules ---- 92
Rhodonite ---- 106
Riprap ---- 92–93
Riverside County ---- 150
Roofing granules ---- 92
slate ---- 86
tile ---- 99
Rubble ---- 92–93
Rubies ---- 92
Russian River gravel ---- 90
Ruthenium ---- 57
Sacramento County ---- 151
Salines ---- 124–133
'Salt cake' ---- 133
Salt ---- 132
producers, 1928 ---- 132
production, 1887–1928 ---- 133
San Benito County ---- 151
San Bernardino County ---- 152
San Diego County ---- 153
San Francisco Bulletin, cited ---- 29
County ---- 153
San Joaquin County ---- 153
San Luis Obispo County ---- 154

Page
San Mateo County ---- 154
Sand and gravel ---- 90–91
producers, 1928 ---- 186–193
Sandstone ---- 84
producers, 1928 ---- 183
production, 1887–1928 ---- 84
Sanitary ware ---- 99
Santa Barbara County ---- 155
Santa Clara County ---- 155
Santa Cruz County ---- 156
Sapphires ---- 106
Scheelite ---- 63
Semi-vitreous tableware ---- 99
Serpentine ---- 85
Sewer pipe ---- 99
Shale oil ---- 117–118
Shasta County ---- 156
Shoshonite ---- 104
Sierra County ---- 157
Silica ---- 118–119
brick ---- 71
producers, 1928 ---- 184
total production ---- 119
Sillimanite ---- 119–120
producers, 1928 ---- 184
Silver ---- 60–62
chart, prices, bar silver ---- 61
production by counties ---- 61
production, 1880–1928 ---- 62
Siskiyou County ---- 157
Slag for railroad ballast ---- 92
Slate ---- 85–86
producers, 1928 ---- 184
production, 1889–1928 ---- 86
roofing granules ---- 86
Soapstone ---- 120–122
producers, 1928 ---- 185
total production ---- 122
uses ---- 121
Soda ---- 132–133
producers, 1928 ---- 185
total production ---- 133
Solano County ---- 158
Sonoma County ---- 158
Spark plugs, andalusite for ---- 119
Specific gravities of oil produced ---- 31
Spelter. (*See* Zinc.)
Spessartite ---- 106
Standard Oil Bulletin, cited ---- 31
Company, cited ---- 27–32
Stanislaus County ---- 158
State Mineralogist Report, cited ---- 29, 52
list of ---- 199–208
Mining Bureau, cited ---- 12, 19
Oil and Gas Supervisor, cited ---- 27–28
Steatite ---- 121
Stocks of copper in United States ---- 47
platinum in United States ---- 58
Stone, miscellaneous ---- 86–94
producers, 1928 ---- 186–193
production by counties ---- 92–93
production by years ---- 94
Stoneware ---- 99
Strontium ---- 122–123
Structural materials ---- 68
Stucco dash, granules for ---- 92
Sand ---- 90–91
Sulphur ---- 123
Sutter County ---- 159
Talc ---- 120–122
uses ---- 121
Tehama County ---- 159
Terra cotta ---- 99
Terrazzo, granules for ---- 92
Titanium ---- 63
Tile ---- 99
Tin ---- 62–63
producer, 1928 ---- 193
Topaz ---- 106
Tourmaline ---- 106
Travertine ---- 83–84
Trinity County ---- 160

Page
Tube mill pebbles ---- 89
Tuff, used for building stone ---- 76
Tulare County ---- 160
Tungsten ---- 64–65
producers, 1928 ---- 193
total production ---- 65
Tuolumne County ---- 161
Turquoise ---- 106
United States Bureau of Mines, cited—24, 25, 30, 31, 46–47, 50, 53, 57, 59, 62, 67, 86, 117
Census Bureau cited ---- 134
Geological Survey cited ---- 19, 52, 54, 62, 64, 82
Vanadium ---- 65–66
Ventura County ---- 161
Vitrified brick ---- 71
Volcanic ash ---- 115–116
cinders ---- 92
Water glass ---- 118
Weber Construction Co. ---- 87, 88
Witherite ---- 97
Wolframite ---- 64
Yale, Chas. G., cited ---- 51
Yolo County ---- 162
Yuba County ---- 162
Zinc ---- 39, 66–67
chart, prices slab zinc ---- 66
total production ---- 67
trend of world production ---- 39

o

71043 1-30 3M

STATE OF CALIFORNIA
DEPARTMENT OF NATURAL RESOURCES
FRED G. STEVENOT, Director

DIVISION OF MINES
FERRY BUILDING, SAN FRANCISCO

WALTER W. BRADLEY State Mineralogist

San Francisco] BULLETIN No. 103 [September, 1930

394.9
C1.213

CALIFORNIA MINERAL PRODUCTION FOR 1929

By
HENRY H. SYMONS

78851